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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the necessity of further Experiments on Friction, especially upon Railroad Frictions, or the Friction of Metals in motion, under heavy insistent weights and small surfaces of pressure. By ELLWOOD MORRIS, Civil Eng.

The importance of a correct knowledge of the laws of friction can hardly be exaggerated, as without this knowledge, the finest conceptions of the mechanic and engineer would fail to realize their appropriate results. In modern times these laws have received great attention, and yet in some of the most important frictions of the day, the experiments which guide us are both *inadequate and anomalous.*

A long roll of the ablest mechanical philosophers have devoted themselves to illustrating the friction of substances:—from Amontons (1699), through Coulomb (1781), Vince (1785), and Rennie (1829), down to Morin (1831-4), who, under the direction of the Government of France, made an elaborate series of experiments *on Friction*:—yet notwithstanding all the high intelligence, and the labor expended upon this important subject, the engineers who first came to apply the laws enunciated by the philosophers to the estimation of the frictions between metals under heavy insistent weights as they occur upon railroads, for instance, soon found themselves most wofully at fault.

Although Amontons, De La Hire, and Euler had assumed the coefficient of rubbing friction between hard bodies (without unguents,)

to be usually about $\frac{1}{3}$d of the insistent weight. Rennie, and other acknowledged authorities, had shown experimentally, that without unguents the rubbing friction between hard metals might "*very generally be estimated at about* $\frac{1}{6}$th *of the pressure*"*—but this (in Rennie's trials,) was with small insistent weights of less than 33 lbs. to the superficial inch of contact, and we may here say, that all the mechanical philosophers limited the deductions from their experiments "*within the limits of abrasion*"—and though Morin showed that all frictions without unguents produced some slight abrasion, this militates not against our generalization, as under the moderate insistent weights employed in the experiments, that abrasion was necessarily but little—too slight, indeed, to seriously affect results.

Morin's experiments (of which an able digest was published in this *Journal* for 1843), confirmed generally those of Rennie, but the applied weights were not at all adequate in magnitude to represent what we now term "*Railroad Frictions.*"

A reliance upon the results of these philosophers (accurate though they may be within their limited range), led at once to erroneous conclusions, when applied to the heavy frictions of railroads.

A brief illustration of this will suffice:—in 1838, Nicholas Wood, Esq., published in London a much enlarged and carefully revised and improved edition of his valuable and well known Treatise on Railroads—his own experiments therein cited (though made with too small weights,) showed $\frac{1}{6}$ to $\frac{1}{16}$ *adhesion* or *bite* of the wheels of locomotives upon rails; and this adhesion (it is well known) furnishes the fulcrum for their motion, and absolutely limits their progressive power.

Nevertheless, Mr. Wood in the standard work referred to, finally concluded to assume only $\frac{1}{15}$ of the insistent weight as the *effective adhesion* of a locomotive clear of that necessary to move itself!

To show the anomalous condition of the science of friction at that day (1838), though more than four years subsequent to the publication of the bulk of the celebrated experiments of Morin, and nine years subsequent to those of Rennie, we may state, as a curious fact, that in the very same year (1838), one of our ablest and most experienced American civil engineers (B. H. Latrobe, Esq.,) in his famous Report upon the location of the Baltimore and Ohio Railroad, assumed (as the result of experience here) $\frac{1}{7\cdot5}$ as the coefficient representing the *effective adhesion* of a locomotive engine.

We see, then, that upon opposite sides of the Atlantic ocean, at the same moment of time, two of the highest authorities on railroad subjects (both thoroughly acquainted with the accepted laws of friction), were founding the most vital and important conclusions upon *the adhesion of locomotives;* and yet the English authority was assuming that adhesion to be only $\frac{1}{15}$ of the weight upon the driving wheels, while our American authority (as the result of actually existing experience here,) stated it at $\frac{1}{7\cdot5}$, *or precisely double!* And we may here add (with pleasure,) *that Mr. Latrobe was much the nearest right.*

At a long subsequent period (1853), Mr. Latrobe found by careful

* Vol. 119, Philos. Transac., 1820, p. 160.

trials at the opening of the mountain division of the Baltimore and Ohio Railroad, that the performance of the heaviest class of locomotives, with full loads upon the 105 and 116 feet ascending grades of that well known railroad, showed an adhesion in actual work of nearly $\frac{1}{3}$. And in support of this, we may state, that the working of fully loaded locomotive engines on other roads has now shown conclusively, that at low speeds in the haulage of heavy freight we may fully rely *upon an average adhesion of* $\frac{1}{4}$ *of the weight upon the driving wheels of a locomotive;* while under favorable circumstances an adhesion of $\frac{1}{3}$, or even more than $\frac{1}{3}$, will be developed, in defiance of *the maximum of friction* having been fixed by modern writers at $\frac{1}{6}$th.

The late W. R. Casey, Esq., (a civil engineer of eminence,) in an able article published in the *American Railroad Journal* (Sept. 15, 1839), was the first to draw the attention of professional men to the fact that we were largely *under-estimating the maximum adhesion of locomotives;* and he showed conclusively that even in 1836, Baldwin's and Norris's American locomotives had already realized an adhesion of between $\frac{1}{2}$ and $\frac{1}{3}$ of the weight imposed upon their drivers!

These, and other facts, clearly indicated that the laws of friction, as then accepted by the mechanical world, were inadequate to guide us in the new frictions developed by the application of steam power to railroads; and the uncertainty existing in the minds of even professional men, as to the true coefficient of friction, developed by the adhesion of a driving wheel upon a rail, accounts in part for the astonishment with which many engineers witnessed the ascension by locomotives of inclined planes, previously worked by stationary power, and this uncertainty doubtless had its weight in inducing a leading English engineer, (Prof. Vignoles,) even so late as 1844, to name 1 in 50, or a gradient of $105\frac{6}{10}$ feet per mile, as the limit of grade which could be practically worked by locomotive power, though at the present day we know that upon the Baltimore and Ohio, and Virginia Central railroads, gradients of 1 in 20, and even 1 in 10, have (temporarily) been successfully surmounted by locomotives, with passengers.

For the very important discrepancies which are found between the railroad frictions, actually developed by practice, and what they should have been, had they followed the laws laid down by Rennie and Morin—the writer has endeavored to account, (without invalidating the labors of either,) by remarking that all the experiments upon the friction existing between metals in motion, from which the mechanical philosophers have deduced their governing laws of friction, were made *within the limits of abrasion*, and were usually stopped so soon as the metals began to *abrade* each other—while, on the other hand, all railroad frictions are destructive frictions, or those in which the metals in contact *constantly abrade each other.**

It will be seen, then, that the ordinary experiments upon friction are inapplicable to some of the most important *railroad frictions*, and hence there would seem to be a real necessity for further experiments, under the actual circumstances which occur on railroads, or at least

* See Journal of the Franklin Institute for March, 1851, page 152.

with such great weights, and small surfaces of contact, as may more closely assimilate to them.

A somewhat similar view of this subject was taken by the writer, in an article in this *Journal* for March, 1851, in which he argued the probability, that (contrary to the received laws of friction), under great insistent weights and small surfaces of pressure, as between the driving wheels of locomotives, and the rails on which they move, there was strong reason to believe *that friction increased in some ratio to the surface pressed.**

It will be remembered that Rennie and Morin both concur in laying it down as a law, that friction is always "*proportional to the pressure,*" irrespective of the extent of surface pressed or of velocity, and that this is almost universally accepted by the mechanical philosophers of our day, (though recent French experiments indicate that velocity should not be neglected;) if then it can be established that within the important range of railroad frictions, whether owing to abrasion, or any other cause, "*friction actually increases in some ratio to the surface,*" and not wholly irrespective of it, (as now taught,) important consequences can hardly fail to flow from such conclusion, and the necessity of further experiments to establish the laws of *abrading frictions*, between metals in motion, will become apparent.

In his article of 1851, the writer said: "When engines slip their wheels on railways, both wheels and rails *abrade*, the law of friction changes, and we enter at once upon a new field, in which we have no exact results recorded, and of which we only know that the coefficient of friction is greatly increased."

The writer had frequently computed the *adhesion* of locomotives from actual loads drawn by them on railways of known grade, and like other engineers had found, that the adhesion exhibited, far exceeded the extreme limit of $\frac{1}{8}$, laid down as the *maximum* by Rennie and Morin; and he had also noticed that fully loaded locomotives, in passing from broad to narrow rails, *invariably slipped their wheels, upon striking the narrow rail;* and hence, in the article of 1851, he inferred that the adoption of rails of the top width of the available wheel tread, (say 4 inches,†) would largely augment the ascensive power of locomotives on high gradients;—since then a striking fact has been made known, which seems to confirm, in a conclusive manner, the accuracy of the views then taken, on this important point in railroad affairs.

The fact referred to, has been developed in the working of the Mine Hill and Schuylkill Haven Railway, a heavy coal road; the Chief Engineer of this work, R. A. Wilder, Esq., (an able and experienced officer,) states to the editor of the *New York Railroad Advocate*, (see No. 22,) that upon his road a 92 feet grade laid with narrow topped rails, is immediately succeeded by a 130 feet gradient, on which rails of full width are placed, and in the working of this road with heavy coal trains, "it is found that an engine can draw more (ascending)

* In the article referred to, an error of the press made the writer say, "in the same ratio to the surface," instead of "*in some ratio to the surface,*" as he wrote at the time.

† Some able engineers, as William Parker, Esq, and J. W. Brooks, Esq., have advocated, and to a limited extent have used, rails 3 inches wide on top, though with a different object in view.

upon the 130, than on the 92 feet grade, although the actual resistances on the former grade are full 33 ℔ cent. greater than on the latter." We quote here the words of Zerah Colburn, Esq., the well-known editor of that excellent railroad paper; and we think he might fairly have estimated the resistances upon the 130 feet grade, as being full 40 ℔ cent. over those of the 92 feet gradient, since gravity alone upon the former, would amount to 55 lbs., and on the latter to only 39 lbs. per ton of 2240.

In observing various of the frictions connected with railroads, the writer has been irresistibly led to the conclusion, that friction between metals, under heavy weights, must increase in some ratio to the surface pressed, or to the weight imposed, or to the velocity, or in combined ratio of the three;* and he is glad to find, that many intelligent mechanics (struck by the anomalous results of our present theory of rubbing friction, when great weights or severe pressures are in action), are beginning to entertain similar views.

It is a singular fact, that one of the series of Rennie's experiments, (Table viii, p. 159, 119th vol. *Philos. Transac.*, 1829,) although evidently regarded as anomalous by him, nevertheless sustain fully, as far as they go, some of the views above expressed; made under much heavier weights, in proportion to the surface pressed, than in Rennie's other experiments, and pushed in some instances up to or beyond the limits of abrasion; they represent more nearly the conditions of railroad frictions, and they give far higher coefficients for the friction of iron on iron, without unguents, than any other of Rennie's experiments; these coefficients augmenting with the weights imposed, varying from $\frac{1}{2}.\frac{1}{4}$ to $\frac{1}{4}$, and averaging $\frac{1}{3}$! Nevertheless, Mr. Rennie, in his general conclusions, while deducing the laws of friction from his experiments, passed almost unnoticed over this remarkable table (No viii), and assumed the rubbing friction between hard metals without unguents, as being only $\frac{1}{6}$, whilst in no single instance of iron on iron recorded in that table, was the coefficient of friction less than $\frac{1}{4}$th!

In the trials recorded in this table (No. viii), the insistent weights varied from 186 to 560 lbs. per square inch, and the coefficients of friction with the same surface in action, (6 square inches,) constantly augmented with the weights from $\frac{1}{4}$ with the former, to $\frac{1}{2}.\frac{1}{4}$ with the latter pressure! So that it may ultimately prove, that a correct formula for friction in such cases, may have to involve both weight and surface, and perhaps also time and velocity, instead of being in ratio of the weight alone, irrespective of time, surface, or velocity, as laid down by Rennie and Morin.

But even the highest pressures used by any of the experimentalists are but small, when compared with those imposed in the working of railways, upon the driving wheels of locomotives, on each of which 4 tons in this country, and 6 tons in England, are common weights.

Now, if in consequence of unavoidable deflections in the track, we admit that the practical bearing of a locomotive wheel upon a rail, may

* Professor Renwick (1832) recognised the necessity of this, and proposed a formula, embodying *pressure, surface, and velocity*. See Renwick's Mechanics (p. 120).

be so much as $\frac{1}{2} \times 2$ ins., we have only one square inch of surface of iron to resist an imposed weight of from 8960 to 13,440 lbs!

No such weights per superficial inch have ever been used by the mechanical philosophers in their general experiments upon friction, and therefore none of these can fairly be said to represent the conditions of *railroad frictions;* for in these frictions the comparatively enormous weights applied render *abrasion* certain and unceasing, while in deducing the general laws of friction, the experiments which involved material *abrasion* have been uniformly set aside.

Mr. Casey, in the article before quoted, has shown that it is quite probable the *adhesion* of locomotives in certain cases has even exceeded $\frac{1}{2}$, and every engineer knows that it very often far exceeds $\frac{1}{6}$, though the latter is the *maximum* coefficient allowed by those experimentalists who are now recognised as being the highest authorities upon the laws of friction; further experiments are therefore unquestionably necessary to settle this important point in the science of mechanics, and it is to be hoped that they may soon be undertaken upon a suitable scale.

Although Rennie and Morin (on whose experiments the usually accepted laws of friction are mainly based,) decided unequivocally, that the coefficient of friction depended solely upon the pressure, "without regard to surface, time, or velocity;" nevertheless, an earlier philosopher (Dr. Vince), whose experiments were well known to both, had shown (vol. 75, Philos. Transac., p. 175), that "the friction of a body does not continue the same when it has different surfaces applied to the plane on which it moves, but that the smallest surface will have the least friction," and this is to be understood as within the limits of abrasion.

Notwithstanding Dr. Vince's conclusions have usually been disregarded by modern philosophers upon the ground that his experiments were on a scale too limited to establish mechanical laws; nevertheless, it would appear quite probable, that under certain circumstances the deductions of Dr. Vince may be found the most correct, as scarcely any branch of mechanical science is based upon experiments so anomalous in their character as those from which the usually received laws of friction have been inferred by a generalization *evidently forced.*

Nor is this observation too strong, when we recollect that Rennie, after showing by table No. viii of his paper, that iron on iron, without unguents, and with only ordinary pressures, had a friction of over $\frac{1}{3}$, yet finally adopted a frictional coefficient for this very case of only $\frac{1}{9}$th!

Morin in another case, that of hard woods with unguents (to which we shall again refer), adopted $\frac{1}{8 \cdot 2}$ as the coefficient of the friction of rest, and $\frac{1}{11 \cdot 7}$ as that of motion; whilst the experiments made upon a large scale by a Committee of the Franklin Institute, showed that these coefficients were in reality *less than half as great as those announced by Morin!*

The writer will now refer more particularly to some striking anomalies in the friction of heavy weights on wood, *with unguents,* which are remarkable as indicating the inaccuracy of some of Morin's coeffi-

cients, when applied on a great scale to heavy masses in motion upon lubricated wood.

In vol. vii of the 3d series of this *Journal*, p. 103, will be found an elaborate Report by a Committee of the Franklin Institute (of which the present respected President of the Franklin Institute was chairman), on the coefficients of friction developed at the launching of the U. S. war vessels, the *Raritan* (a heavy frigate), and the *Princeton* (a large war steamer)—they show conclusively that *the friction of rest* of these vessels upon wooden ways, well lubricated with *tallow*, was about $\frac{1}{15}$, while the *friction of motion* was about $\frac{1}{30}$th. Now, Morin (as above stated,) gives a coefficient nearly as high as $\frac{1}{6}$ for the former and $\frac{1}{14}$ for the latter; the differences being *over one hundred per cent.* Had Morin been correct these vessels would not have launched at all, instead of moving off as they did of themselves the moment the stay blocks were sawn asunder.

The *Raritan* was estimated to weigh 1200 tons, and her pressure on the ways was 3560 lbs. per square foot, while the *Princeton* weighed 577 tons, and had a pressure on her launching ways of 2280 lbs. to the superficial foot.

These conclusions of the Franklin Institute, notwithstanding their extraordinary variance from the coefficients of Morin, are in close accordance with similar experiments in England and France, as quoted by Rennie (vol. 119, Philos. Transac., p. 155), where the *Salisbury*, a frigate of 58 guns with a pressure of 6336 lbs. per square foot upon her launching ways, and *soft soap* for the lubric, had a coefficient of friction of $\frac{1}{28}$th—while for similar cases, with *hogs'-lard* for the unguent, and a pressure of 7056 lbs. per square foot, Coulomb made the coefficient of friction $\frac{1}{27}$th, and with *tallow*, Coulomb made this coefficient $\frac{1}{28}$th.*

We may therefore conclude, that whether with hard metals without unguents, or with hard woods lubricated with the usual lubrics—as in the adhesion of locomotives in the former, or in the launching of men-of-war in the latter case—Morin's coefficients of friction *are entirely inadequate* to represent the facts, being in the case of *adhesion* but half as great as practice indicates; while in that of *launching ships* they err the other way, being twice too large!

It is quite probable, that the recent extraordinary difficulties attending the famous launch of the *Leviathan*, arose from an under-estimate of the friction of abrading surfaces of iron, of which the coefficient under the circumstances doubtless exceeded $\frac{1}{3}$, while if our recent books were relied on, it would have been assumed at $\frac{1}{6}$—a difference great enough, in such a vast weight, as to have created all the difficulty and extra cost which attended that celebrated launch, and called forth all the resources of the distinguished engineer in charge.

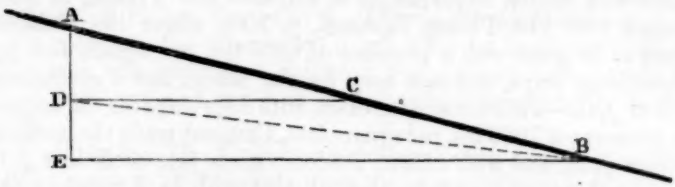
We can hardly therefore avoid the conclusion, that the laws of friction as now received, if applied to the heavy pressures often used, *are entirely inadequate, and that further experiments are necessary to the correct solution of many practical problems.*

* See Renwick's Mechanics.

Should any such be undertaken, the writer would suggest that a long inclined plane be used, and great sliding weights, so as to assimilate the case to that of launching ships—then by an automatic contrivance, such as was devised by that able mechanic, Joseph Saxton, Esq., and used by the committee of the Franklin Institute at the launches of the *Raritan* and *Princeton*, the exact motion of the body under trial, in seconds, or parts of seconds, could be correctly marked upon a tape, and the following simple formula, (drawn up at the time by the writer, as a member of the committee referred to,) will determine the coefficient of the friction of motion, of rest, (by taking the space described in the first, second, or half second,) or of both combined.

We here re-print, with some slight modifications, the following note to the Report of the Committee on the Launches, which was drawn up for them by the writer, and exhibits a simple formula for determining the friction of inclined planes, as well as a graphic mode of representing the inclination of the plane of the friction of motion, or angle of friction:

"Another method of considering the subject of friction, upon inclined planes, has been suggested by a member of the committee, which results in a formula different from that we have employed.



Thus calling A C=S, the space actually slid over in a given time, t, by any body descending an inclined plane.

A B=S′ the space which the body would have described by theory in the given time, $t=\frac{1}{2}gt^2$ sin. i, friction being null.

A B E=i, the angle of inclination which the plane forms with the horizon.

D B E=f, the angle of friction due to the body in motion.

"Then A E, being the total vertical space through which the body would have fallen in the given time, t, if friction had not existed; and A D, being the actual vertical space fallen through in the given time, t, it follows that D E represents the retardation due to the friction of the body upon the plane A B. D B E will be the angle of friction of the body, and $\frac{\text{D E}}{\text{B E}}$ will be the tangent of the angle, f, or coefficient of the friction of motion pertaining to that body.

"Knowing then simply the actual time occupied by the sliding body, in descending any measured distance along the plane, the formula, for finding the coefficient of its friction, will be

$$\text{Tang. } f=\text{Tang. } i\left(\frac{S'-S}{S'}\right)$$

which represents all the resistances encountered by the moving body.

"By this formula the angle of friction of the *Raritan* frigate, computed from a time of 11 seconds, occupied in sliding 59 feet, upon a slip of 3° 40′ slope, is 1° 55′, the coefficient of friction, or natural tangent, of that angle being ·0336, or nearly 1-30th.

"The angle of friction of the *Princeton* steamer, computed by the same formula, from a time of 5¼ seconds, occupied in sliding 19·62, feet upon a slip of 4° 25′ slope, is 1° 53′,

the coefficient of friction, or natural tangent, of that angle being ·0328, or rather more than 1-30th.

"The mean of these two results, gives an angle of friction, for launching such vessels as these, of 1° 54′, or a coefficient of friction of very nearly 1-30th."

So that the angle of the friction of motion in launching men-of-war, may be fairly assumed at 2°, and the proper declivity of the launching ways at 4°.

We cannot conclude this article without referring in terms of commendation to the old experiments on friction made in the last century by Coulomb, Vince, and Ximenes*—and although these have been lightly laid aside by more recent philosophers, they seem in fact to be much more applicable to practical affairs, than the more elaborate experiments of Rennie and Morin.

Road Paving.†

To the Editors of the Mechanics' Magazine.

GENTLEMEN:—A letter under this head appeared in your last valuable number, from Mr. Holland, of Woolwich, recommending alternate rows of stone and wood as affording a good foothold for horses, and constituting a most valuable improvement in street paving.

Your correspondent will find his sensible suggestions carried out in some paving I recently laid down at the Holborn end of Little Queen street, by the authority of the District Board of Works.

This improved system has been in operation for some years, and I am enabled to state that it not only affords a good foothold to horses, but it possesses the other valuable advantages of freedom from mud, dust, and noise, and, being cast in blocks of large dimensions, affords great facility for access to the water and gas mains.

I remain, gentlemen, your obedient servant,

FRED. BRAITHWAITE.

46 Berners street, June 9, 1858.

[We cannot allow the above letter to pass without adding a few words respecting the paving which our experienced correspondent here brings to our notice, especially as he is eminently well qualified to pronounce an opinion upon the subject, having acted as a Member of the Council of the Institution of Civil Engineers for many years, and as a Commissioner for a large London paving district in St. Pancras. The patent composite paving referred to by Mr. Braithwaite, is a composition of creosoted wood and broken Guernsey granite, cemented together in alternate rows with mineral asphalte, and cast into blocks 24 inches in length by 15 wide and 8 deep. They may, however, be moulded into any other shape or size, and may be entirely composed of broken granite, as some of the blocks in Little Queen street now are, for the satisfaction of those Commissioners who have an objection to wood in any shape or form. It has been found, nevertheless, that, however objectionable wood in its natural state is admitted to be as a material for paving by itself, its introduction in conjunction with these

* For an excellent summary of these, see Renwick's Mechanics.

† From the London Mechanics' Magazine, June, 1858.

blocks, when rendered impervious to water by creosote, constitutes a very valuable feature in the improved system. The blocks, when laid down to a proper curve, and when their joints have been run in with asphalte, form an arch capable of sustaining the heaviest traffic; and being impervious to water, provide most effectually against noxious emanations from gas mains and putrid sewers, by which the inhabitants of the metropolis have been of late so frequently afflicted. The blocks can be taken up to get at gas and water mains, and relaid with greater facility than any others now in use, and they never can sink into ruts as the narrow granite blocks recently introduced frequently do, when acted on by wagon wheels.

In a report made on the 10th of May to the Commissioners of the Holborn Board of Works, Mr. Braithwaite speaks very highly of the composite paving, pronouncing it superior to every other paving material that has come under his notice, and entering at considerable length into a statement of its advantages. After adverting to its general excellence, he says:—"The substitution of machinery for manual labor in the manufacture of these composite blocks is another feature which I find very important in an economical point of view, as a given number of square yards of this paving can be prepared and laid down in as many hours as days are now required for granite blocks." He then contrasts the new system with that of Macadam, and asserts that the former gets rid of many of the evils of the latter, adding:—"The most satisfactory evidence that can be adduced in support of this fact is that a specimen of this (the new) system which I have seen in a coal merchant's yard at Greenwich, where it has been for upwards of three years exposed to the heaviest traffic without requiring any repairs, while the adjoining Macadam required to be renewed every two or three months, in order to keep it on a level with these composite blocks; and I can also advert to the specimen laid down in Southampton street, where similar frequent renewals of the Macadam were required, and where, notwithstanding the Pickford vans and other heavy traffic proceeding along this street from Holborn to the Euston square Railway Station, including during a portion of that time the whole of the traffic of Holborn itself, while that great thoroughfare was being repaved. I could not discover, on measuring these blocks, that there was a greater reduction in any of them by this wear and tear, than from an eighth to a quarter of an inch, nor any symptom of a rut or hollow on the surface of any of them. . . . . Another advantage to rate-payers, as well as to inhabitants, in an economical as in a sanitary point of view, must be obvious from the material diminution of such nuisances as mud, dust, and watering carts."

We have been induced to extend these remarks thus far, because during the last week or two the obstructions occasioned by the renewing of the common street paving have been so great in some of the most crowded thoroughfares of the city, that a satisfactory method of reducing the evil thus occasioned deserves the utmost encouragement.—Eds. M. M.]

*On the Resistance of Tubes to Collapse.** By WILLIAM FAIRBAIRN, Esq., C. E., F. R. S., &c., &c.

(Continued from page 151.)

[Read before the British Association.—Section G.]

The next series of experiments were of a different character—more approaching to actual practice; and, in order more fully to confirm what had already been laid down, tubes were made of larger diameter, and of plates six times the thickness. The first were of an elliptical form—one constructed of thin plates ·043 inch thick, and the other of plates ¼ inch thick. The axes of the transverse section of the first were 14 and 10¼ inch, and of the second 20¾ and 15½ inch. The thin tube was 5 feet long, and the ¼-inch plate tube was 5 feet 1 inch long. These being duly prepared were submitted to the usual test, and the first collapsed with 6½ lbs. on the square inch, and the second with only 127 lbs. on the square inch.

On comparing the elliptical tube, whose longer diameter was 20·75 inches, and its conjugate 15·5 inches, with the cylindrical tube T in the next table, of 18·75 inches diameter, and of the same length, thickness of plates, and nearly of the same sectional area (the sectional area of metal on the elliptical tube being 14 inches, and in the cylindrical 14⅓ inches,) we have for the collapsing pressure of the elliptical tube 127·5 lbs. to the square inch, and 420 lbs. for that of the cylindrical tube, where it will be observed that there is a loss of more than ⅔rds, or of nearly ⅔ths the strength; or, in other words, a cylindrical flue will sustain three times the pressure that could be supported by an ellipse of the same weight of metal, and proportioned like tube S.

From these facts it is obvious that in every construction where tubes have to sustain an uniform external pressure, the cylindrical is the only form to be relied upon, and that any departure from the true circle is attended with danger.

In order to ascertain the different powers of resistance of tubes composed of thick plates and of different diameters, a strong tube only 9 inches diameter, and formed of ¼-inch thick plates, was constructed to match and compare with the tube T, also of ¼-inch plates, but 18¾ inches diameter. The 9-inch tube was, however, found to be considerably beyond the retaining powers of the cylinder, which it would not have been safe to have trusted above 500 lbs. on the square inch. Finding the strength of the small tube too great for the containing vessel, two new tubes were made—one with a lap-joint, as at A, in the annexed sectional figure, and another with a butt-joint, as at B. These tubes were made of plates about ⅛th of an inch thick, the object of this difference being to ascertain to what extent the resisting power of the tube was reduced by the lap-joint. In the construction of boilers the lap-joint is almost invariably in use; and it must at once appear obvious that any departure from the true circle in cylindrical tubes must injure their powers of resistance to compression.

* From the London Artizan, October, 1857.

The tube V, experiment 25, was made with a lap-joint, which caused it, as already remarked in ordinary constructions of boiler-flues, to depart from the true circle to the extent of nearly ¼ inch the thickness of the plates. In the tube W, experiment 26, the cylindrical form was better maintained by the butt-joint; and after careful measurement with the callipers, the difference between the two, as respects the cylindrical form, was 14 inches. This comparatively small difference had, nevertheless, a serious effect upon the resisting powers of the tube, which, according to the results in the above table, caused a loss of more than one-third of the strength of the tube, the difference being as 262 for the lap to 378 for the butt-joint, or in the ratio of 69·3 : 100, or as 7 : 10 nearly. These facts are so conclusive as to point to an entirely new construction in the manufacture of tubes calculated to sustain an uniform external pressure, and the results are so conclusive as to show the necessity of adhering in every construction of this kind to the *true cylindrical form.*

During the investigation of the question of the comparative resisting powers of tubes to collapse, another one of probably equal importance arose as to the relative powers of cylindrical tubes to resist internal force acting uniformly over their surface. It has already been demonstrated that the resistance of cylinders to internal pressure is directly as the diameters; but what effect the length may have upon the strength of a tube has yet to be determined. We have already seen that a cylindrical tube, when subjected to external pressure, loses one-half its powers of resistance when the length is doubled. Hence arose the question, what effect, if any, will an increase of length have upon a tube exposed to internal pressure? To solve this problem, three tubes of precisely the same diameter and same thickness of plates, but of different lengths, were prepared and submitted to the test of experiment as follows:

TABLE VII.

Resistance of Tubes with Lap and Butt Joints.

Marks.	No. of experiment.	Diameter of the tube.	Length of tube.	Thickness of plates in parts of an inch.	Pressure of collapse in lbs. per sq. in.
		ins.	ft. ins.		
U	24	9	3 1	·25	—
V	25	9	3 1	·14	262
W	26	9	3 1	·14	378

TABLE VIII.

Resistance of Tubes to Internal Pressure.

Marks.	No. of experiment.	Diameter of the tube.	Length of tube.	Thickness of plates in parts of an inch.	Pressure in lbs. per sq. inch, to produce rupture.
		ins.	ft. ins.	·043	
X	27	6	4 0	·043	375
Y	28	6	2 6	·043	230
Z	29	6	2 0	·043	235
&	30	6	1 0	·043	475
Aa	31	12,13	5 0	·043	110

Considerable discrepancies occur in the experiments on internal pressure, as the whole of them gave way at the riveted joints. Every precaution was taken, by careful riveting and brazing, to render them as

nearly uniform in strength as possible, but nevertheless they strengthen the conclusions arrived at some years since, that the strengths of riveted joints of malleable iron plates, are nearly as the numbers

100 for the plate,
70 for double riveted joints,
50 for single riveted joints.*

These experiments pointed out that riveted joints reduced the ultimate strength of boilers in the ratio of the metal punched out for the reception of the rivets, as shown in my recent publication, entitled "Useful Information," new edition, p. 36.

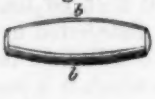
This constant failure at the joints renders the experiments on internal pressure less satisfactory, as they do not exhibit the ultimate strength of the plate, but the strength of the joint of which the tubes were composed. Jointed tubes and flues are almost always present in boiler constructions—the small tubes of locomotive, marine, and multitubular boilers being the only ones which are without joints; hence these facts are probably not less important when applied to such constructions.

On a careful examination of the fractures, the tube X, 4 feet long, seemed the most perfect; Y was not so well soldered, and burst, by tearing off the heads of the rivets; and Z was partly torn through the plates and partly through the rivets. The plate of which this tube was composed was, however, exceedingly brittle, and broke like cast iron. Tube Aa was ruptured in the same way and in the same direction as the others; the rivets were torn through the plates, and the soldering, not very sound, was ripped up for 10 inches along the joint: this tube, as also Y and Z, would have borne a greater pressure had the joints been more perfect and of sounder workmanship.

Taking into account the above discrepancies, it will be impossible to deduce any formula, or establish any result calculated to direct our practice as to the effects produced upon the resisting powers of tubes, when the length is increased; comparing, however, the tube, &c., 1 foot long with the tube X, 4 feet long, and assuming that the joints were equally perfect in each, it is evident that the shorter the tube the greater its powers of resistance. This may arise from the ends being perfectly rigid and unyielding, which, in short tubes, would reduce the pressure upon the middle and unsupported portion in a given ratio of the length of the tube. For example, let us take two tubes of any given diameter, the one 10 feet and the other 20 feet long; it is evident that it is much easier to force the long tube into the form of a barrel, as *a a*, Fig. 2, than it would be to produce the same form in the shorter tube, as at

Fig. 2.

Fig. 3.



b b, Fig. 3. To prove this, let us suppose the material to be perfectly elastic, and capable of extension, such as a tube of vulcanized India rubber, or any other elastic materials, and we have at once the solution

* "Philosophical Transactions." Part II., 1850, p. 677.

to the question, that the extension does not take place at the ends, but in the middle, where the particles of the material possess diminished resistance, arising from their respective distances from the ends or points of support.

To ascertain how far this view is correct, two lead pipes were prepared of 3 inches diameter, and of the respective lengths of 1 foot 2½ inches, and 2 feet 7 inches; and these were submitted to the following experimental tests:—

TABLE IX.—*Resistance of Lead Tubes to Internal Pressure.*

Marks.	No. of experiment.	Diameter of tube.	Length of tube.	Thickness of metal in ins.	Pressure to produce rupture in lbs. per sq. inch.	REMARKS.
		ins.	ft. ins.			
Ab	32	3	1 2½	·25	225	With 225 lbs. pressure one of the ends was blown out.
	33	3	1 2½	·25	374	Burst with 374 lbs.; but before rupture the tube had assumed the barrel form, as at Ab, and on measuring the circumference, the metal had elongated 1¼ ins.
Ac	34	3	2 7	·25	325	
	35	3	2 7	·25	364	

The tube Ab ruptured at the thin part of the metal, the water bursting through a narrow slit about 3 inches long. The lower end of the tube Ac was also blown out with a pressure of 325 lbs., and after being repaired and secured by bolts and clasps, it was eventually ruptured with a pressure of 364 lbs. on the square inch. The same amount of elongation of the material was observed in this as in the shorter tube—namely, 1½ inches, and the only difference was in the position of the enlargement of the diameter, and the fracture, when the tube gave way, represented by a thin, narrow slit.

It is probably difficult to assign the reason why cylindrical tubes of uniform texture should follow the law indicated by the experiments, as that of beams or hollow tubes, circular or rectangular, subjected to a transverse strain. Where the force or pressure is applied on the principle of equal distribution, that is, where the load is uniformly distributed over the surface of the beam or tube, or, what is the same thing, when one-half that force is applied to the centre, it requires greatly increased strength in the middle, and greater rigidity, to equalize the pressure, and to make the beam or tube equal in its powers of resistance in all its parts. If, for example, we make a circular or rectangular tube of uniform thickness throughout its whole length, it will be found that on loading it in the middle, or with double the load equally distributed over the surface, with a weight sufficient to break it, that it will yield in the middle, or the most distant point from the ends on which it is supported. This point being the most distant from the centre round which the forces revolve, is acted upon with greatly increased force, and consequently requires a proportionate increase of strength.

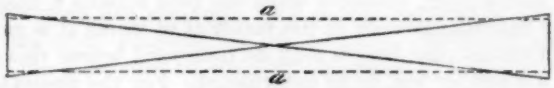
To render, therefore, a perfectly uniform tube in diameter equal in

its powers of resistance to an equally distributed external pressure over the whole of its surface, it would require it to be constructed in the form given below (Fig. 4), where the thickness of the material in the middle is duly proportioned to the length of the cylinder, and that upon the same principle as that which applies to beams subjected to a transverse strain. Were it otherwise, the tube would collapse in the

Fig. 4.

middle; and supposing perfect uniformity in the thickness of the material throughout the whole length of the tube, collapse would ensue in the middle, and would take the form indicated at *a a*, Fig. 5, the weakest point, where the greatest force of collapse must of necessity ensue. On this principle of construction we are obviously defective; and it is quite evident, that in every case where it is desirable to have uniformity of strength in all parts of a tube intended to resist uniform

Fig. 5.



external pressure, we must either thicken the circumference proportionally along its length, the thickest part being in the middle, or we must use the simpler means of surrounding or hooping the tube by external rings that will increase the power of resistance in the ratio of the length of that tube. This has all along been indicated by the experiments; and having thus ascertained the law of resistance of tubes to the forces thus applied, we must of necessity follow that law in all constructions where the pressure is uniform and equal over the whole surface of the tube.

Summary of Results relative to the Resisting Powers of Tubes of different lengths.

Reasoning upon the results derived from the experiments upon the 4 inch tubes, we find the force of collapse follows the same law as those contained in the experiments on the 6 inch and other tubes. Thus, taking the results given in Table I, in which the tubes are of the same thickness, and of 4 inch diameter, we find that the pressure of collapse varies according to the length of the tube, as follows:

Diameter.	Length.	Collapsing pressure.	
4	19	170	mean, 153·5
4	19	137	
4	40	65	" 65·0
4	38	65	
4	60	43	43·0

From the above, we deduce that the resistance of the 4 inch tubes

varies inversely as their lengths, and this law we have found confirmed by all the other experiments. Thus, for instance, assuming that the lengths of the tubes in the above table were 20, 40, and 60 inches, and that the resistance of a 40 inch tube is 65 lbs., we find by the law that the resistance of a 20 inch tube would be 130, and that of a 60 inch tube would be 43 lbs. per square inch; and these calculated results correspond nearly with the pressures as indicated by the experiments, and given in the table. In conducting experiments of this kind, it is next to impossible to form tubes, where the joints have to be soldered and riveted, theoretically correct, and certain allowances must therefore be made for discrepancies which must of necessity occur in their powers of resistance to strain. It is nevertheless obvious, that after making these allowances for inaccuracies of construction, the results of the experiments approximate so near the truth as to afford unmistakable evidence that the tubes follow the same law in their resistance to collapse as a hollow beam supported at each end and subjected to a transverse strain, the strength in each case varying inversely as the length; or, in other words, a tube 10 feet long will resist twice as great a pressure as a tube 20 feet long of the same dimensions, and so on for every other length, the resistance being inversely as the increase of that length, probably until the tube attains a length equivalent to the resisting powers of the material of which it is composed.

To what extent the length may be increased before this law ceases to act, is a question yet to be determined. For the present, however, there is sufficient data to show that any increase to the length of a tube within certain limits has a serious effect upon its ultimate strength, and its powers of resistance to strain. This is an important question, and one which affects the strength of all descriptions of pipes and tubes; and it would be interesting to know to what extent a tube of any given diameter could be carried before it began to deviate from the law of resistance which governs the shorter lengths. If, for example, a tube 8 inches diameter, and 1 foot long, collapse with a pressure of 100 lbs. on the square inch, what force would be required to collapse a tube 100 feet long? Now, it is clear from the experiments, that a similar tube 5 feet long would collapse with 20 lbs., and it is equally clear that the same pipe extended to 100 feet in length would not collapse with a pressure of 1 lb. That pressure would certainly be insufficient, as it would require considerably more than a pressure of 1 lb. to destroy the elasticity of the material and produce a permanent set; or, in other words, to force the material out of the true circle.

Having arrived at the conclusion that the strength of tubes composed of metallic plates are in their powers of resistance to external pressure inversely as their lengths, we have now to consider the relation they bear to each other in regard to their diameters. It has already been demonstrated that the strengths of cylindrical tubes, subjected to internal pressure, are inversely as their diameters, and that a tube 2 feet in diameter will sustain double the force required to rupture a tube 4 feet diameter: that is, if the lengths and other dimensions be the same. Bearing this in mind, namely, that the strength of tubes

vary inversely as their lengths, we shall find, on the other hand, on comparing the experiments, in regard to an external compressive force, that they also vary inversely as their diameters.

For example, let us take the 4 inch tubes and compare them with the 8 inch. Taking those of 39 inches long, of which the 4 inch collapsed with 65 lbs., and the 8 inch with 32 lbs., we find by the above law, that as 8 : 65 : : 4 : 32·5, the calculated pressure differing from the experimental by 0·5 only. Again, compare the 4 inch tube, 5 feet long, which collapsed with 43 lbs., with the 6 inch tube, 4 feet 11 inches long, 6 : 43 : : 4 : 28·7, which is 3·3 lbs. less than the experimental pressure; or, taking the 12 inch tube, 12 : 43 : : 4 : 14·3, which is only 1·8 lbs. over the pressure indicated by experiment 19. Again, let us compare the tubes of 2 feet 6 inches in length, assuming the mean of experiments 1 and 4 to be correct, and thence deducing the results for tubes of larger diameter.

Length.	Diameter.	Pressure of collapse by experiment.	Pressure of collapse by calculation.
2 6	6	50 mean	50·0
2 6	8	39 "	37·5
2 6	10	33 "	30·0
2 6	12	22 "	25·0

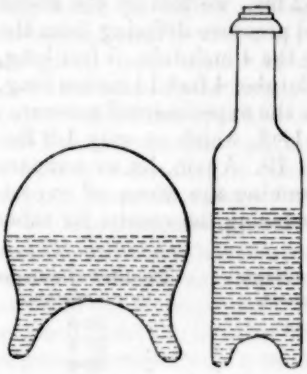
The differences are not great, and may be accounted for as arising from the imperfect construction of the tubes. It would appear, however, that the difference of strength is rather in favor of the smaller tubes, probably because they deviate less from the true cylindrical form. Taking, therefore, the whole of the experiments, and allowing for unavoidable discrepancies, which necessarily arise from imperfections of construction, we arrive at the conclusion that collapse of tubes from external pressure follow the law that their strengths vary inversely *as their length;* and, moreover, inversely as their diameters.

Conclusions to be drawn from the Experiments.

It is interesting to observe how closely nature approximates in her productions to the strongest and best forms. If we look at the tubular forms of grasses, bamboos, and other vegetable constructions of this kind, and taking to account the uses for which they were intended, we shall see that the form contributes greatly to their strength; and we shall, moreover, find that the shoots are telescopic, forming a series of concentric rings, arising from the formation of new and smaller tubes as they emerge in succession from those previously formed. As these again protrude and advance in growth, they leave behind enlarged hoops, or disks, of sufficient rigidity to support and sustain the form of the tubular structure. The same law which pervades natural productions should not be overlooked in art. We have ever before us the lessons of this first great natural teacher; and did we but consult her laws, and in all our applications endeavor to conform to the rules of a philosophy which never errs, and by which nothing is ever made in vain, we should, to use the words of our aspirations after truth, that Nature's laws, and the constructions derived therefrom, constitute the

only true system of philosophy by which we can attain the maximum of strength with the minimum of material.

The sphere is probably the only true form by which we can obtain uniformity of resistance to an uniform pressure, whether external or internal; and to approximate to this, probably, was the reason why our predecessors, from the days of the Marquis of Worcester to those of Watt, adopted the haycock or circular boiler with a hemispherical top and hemispherical bottom, as shown.



This was selected as the strongest form of boiler in the time of Newcomen and Beighton; and it was probably for a similar reason that the glass-blower forms the bottom of bottles with an elevated cone penetrating for some distance into the interior of the cylindrical part. This gives great strength to the bottle in resisting internal pressure, and at the same time reduces the quantity of liquid contained in the bottle; a consideration independent of strength, and probably a matter of no small importance to the retail dealers in wine and ardent spirits.

For the Journal of the Franklin Institute

On the durability of Tubes in the Pirsson Condensers.

By Joseph P. Pirsson.

Messrs. Editors:—My attention has just been called to an article in the *Journal of the Franklin Institute* for August, entitled "Steam and its Condensation, by Thomas Prosser, C. E.;" and in that article are several statements respecting the operation of my condensers, which I desire briefly to correct. These statements have reference chiefly to the durability of the copper tubes of which the surface portion has been generally constructed.

Mr. Prosser states, that "the copper tubes in the condensers of the *Arago* were worn out in less than two years. Those in the *Keystone State* gave out in an incredibly short time. * * * * * The *Fulton* fared no better, as regards her condenser tubes," &c.

The question of durability in the engines of a sea-going steamer is, of course, a highly important one, and in no part more so than in the condensers.

Want of durability in surface condensers had, until the advent of my invention, been the chief objection to their use; for in all previous attempts, this had been found to involve risks far greater than the advantages to be attained would warrant. The chief elements causing the destruction of the instrument, viz: pressure, and expansion and contraction, I have either totally eliminated, or rendered innocuous,

while I have also introduced an entirely new feature in the construction, and upon which only may surface condensation be safely employed. That new feature is the ability to resort to an alternative, in the immediate return to jet-condensation, in case of accident or other necessity. The question of durability in the "copper tubes," is reduced therefore to one of economy simply, since their destruction involves that of no element necessary to the working of the engine, and is consequently wholly unattended by risk of any sort.

When the tubes do give out, either in whole or in part, the only difference perceivable in the working of the engine is the loss of fresh water, in proportion to the extent of the defect, this being a feature belonging solely to my invention.

The question of the degree of wear in the surface portion of my condenser, is reduced to that of the selection of the most durable material, and has nothing whatever to do with the principle. The copper tubes at present in the condensers of the *Arago* are now far in the fourth year of their existence, performing in every respect as well as at first. The same is the case in the *Fulton*, the sister vessel. A few days since, the tubes of the *Augusta's* condenser were examined and found to be in perfect order, after about four years' use. The United States steamship *San Jacinto*, having my condensers on board, has just returned from a three years' cruise, and on examination the tubes were found to be in perfect condition, not having in the meanwhile been touched. Mr. Prosser is amused at the idea of there being any advantage in tinning the tubes. On this head I am not committed, one way or the other; and I will merely cite some facts as to the length of time the "tin will remain." I do this the more readily, as it will serve to explain the reason why tinning was resorted to at all. At the first introduction of my condensers, I had the misfortune to have several sets of tubes made from Lake Superior copper; for experience was wholly wanting then, as to what effect salt water would have upon this metal, as compared with other copper. It was soon found that it would not stand at all. The *Arago* had her *first set* of this copper, and it did not endure for even *two voyages;* and so too, with the *St. Louis*. These were replaced by *pure Spanish copper*, which has proved satisfactory in durability. Messrs. Merrick & Sons were the first to suggest tinning the tubes, with a view to prolonging their wear, and I believe first treated those in the *Quaker City* in that way, and other engineers have followed their example. Over four years ago I put into the *John L. Stevens*, 3000 ton vessel, and *Sonora*, 2400 tons, sets of condenser tubes of pure Spanish copper *untinned*. These, at late accounts, were still in good order.* Whether the tinning is of any material value, I am unable to say; I have, however, been in favor of it. This fact has been proved beyond question, viz: that the condensation is not injuriously affected thereby; while, so far as my observation extends, the tin also adheres to the copper to the last. It would thus seem that the remarks of Mr. Jones, alluded to in Mr. Prosser's article, are fully

* Some, not acquainted with the history of my condensers, may think that I have been peculiarly unfortunate in having so many vessels with defective tubes. These constitute, however, but a fraction of the ships into which they have been introduced, embracing many of the largest and finest ever built.

borne out by the facts cited, as well as that it is important, in an economical point of view, to select the purest kind of copper for the tubes. Additional verification would also appear to be afforded by the result ascertained at the salt works at Salina, New York, where the pans made of this Lake Superior copper have proved very inferior in durability to those of pure Spanish copper.

As these questions are of interest not only to the engineer, but to all connected with ocean steam navigation, I will add that I have also tried brass for the tubes, both tinned and untinned. In the steamship *St. Louis*, as an experiment, one-half of the tubes were of Spanish copper and one-half of brass, both without being tinned. In the Collins steamship *Adriatic*, the tubes were of brass, tinned. Their durability in the latter vessel is of course yet to be determined. In the *St. Louis*, however, thus far, the wear appears to be equal; at least, none of the tubes have worn out, after a period of about four years.

5 Wall street, New York, September 9th, 1858.

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*On Lighting Railway Trains with Gas; with Description of Mr. T. J. Thompson's System.** By Mr. Kitson.

The lighting of railway trains has received comparatively little attention during the progress and improvements in the railway system, the oil lamp having undergone but few improvements, though its defects have been generally felt. Gas possesses important advantages over all the oil lamp arrangements yet produced, in the constant brilliancy of the light, requiring only two lights for each carriage—the saving that may be effected by turning off lights from all unoccupied carriages—the brilliant light thereby obtained for the tail and side lights of the train—and the saving in expense.

The first use of gas, to the writer's knowledge, for lighting railway trains, was in the United States, where an arrangement, which seemed to answer, was tried during 1856, upon the Galena and Chicago Railway. Under the floor of each car is placed a gas-holder, consisting of two tubes, each divided into two compartments by a longitudinal diaphragm of india-rubber. Gas is admitted to the tube on one side of the diaphragm from the gas main at the station, thereby pressing the diaphragm against the side of the tube; and the gas is then forced out to the burners by means of a dry metre or small pump, placed on the car, which pumps in air on the other side of the diaphragm, pressing it back against the opposite side of the tube, and thus forcing out the gas. This arrangement has many advantages for an American railway, where a railway car is so much longer than an English carriage, one car accommodating about 70 passengers; and the number of cars therefore required to form a train sufficient to carry 200 passengers amounting to only 3, whereas upon an English line it would require 11 carriages to accommodate the same number of passengers.

* From Newton's London Journal of Arts and Sciences, August, 1858.

The advantage of the American system of railways for adapting a gas-holder to each car independently is very great, each car being carried upon two trucks, which have their bearings close to the ends of the car, thereby leaving a large unoccupied space, 20 or 30 feet long, which is well adapted for a gas-holder sufficient to supply 6 lights for 12 hours.

The success of these experiments induced Mr. T. J. Thompson to produce an arrangement for the use of gas lights suitable for English railway trains. From the difference between the two systems of working, an arrangement that would answer upon an American railway would be inapplicable in this country: to have the gas-holder above described under every carriage, where a company may have 400 or 500 carriages, would involve an expenditure which could scarcely be repaid by any result; whilst the great difficulty of keeping such a stock of gas-holders in perfect repair, and the annoyance arising from the slightest defect, would prove a constant source of complaint from travelers.

To produce an arrangement suitable for an English railway, two requisites have to be obtained:—first, a gas-holder suitable to supply a train of carriages, and formed of a material not perishable; and secondly, a perfect form of coupling, with which the escape of gas, from neglect or carelessness in putting together a train of carriages, is impossible.

A gas-holder, forming a separate piece of rolling stock by itself, would not be practicable, excepting in cases of very long trains, since the expense of haulage would, to a great extent, counteract the advantage gained by adopting gas in place of oil; and it is therefore necessary that it should form part of the tender or luggage van, or be combined with some other portion of the existing rolling stock. A rectangular gas-holder, upon the ordinary stationary principle, 10 feet long, 7 feet wide, and 3 feet 6 inches deep, would require a mass of water weighing about $6\frac{3}{4}$ tons, a dead weight which would be inadmissible for running over a line; and the motion of such a quantity of water would render it difficult to get a gas-holder to work properly; while the balancing of the gas-holder by weights would also be a complicated arrangement.

These objections have been overcome by the use of a simple form of gas-holder, which can be adapted to the tender or the luggage van, or can be combined with any of the carriages.

A rectangular tank is constructed, having only an aperture 12 ins. diameter in the bottom, where a pipe for filling it with water enters, being brought up for that purpose at the back of the tender; the air escaping through a small pipe while the tank is being filled. The feed-valves are placed at the bottom of the tank; the rods which work them passing through stuffing-boxes, to prevent any leakage of water. Round the four sides of the tank is an outside sheeting, $1\frac{1}{4}$ ins. from the sides of the tank, formed of thin wrought iron plates, about No. 16 wire gauge thickness, which is fastened round the bottom of the tank to a wrought iron frame. This gives a space round the tank, $1\frac{1}{4}$ inches in

breadth (the depth of the tank), which forms the water space for the gas-holder to work in; the roof of the gas-holder, when empty, being 1 inch above the roof of the tank. The outside sheeting and the sides of the gas-holder are carried up 12 inches higher than the roof of the tank, so as to allow for variation in pressure of the gas. At the four corners of the tank are placed guide-rods, which are fastened into the bottom frame, and stayed at the top by light wrought iron stays, riveted to the top of the outside sheeting. These guide-rods are placed in the water space, and brass roller guides are fixed at the top and bottom of each corner of the gas-holder, which work upon the guide-rods. Round the bottom of the gas-holder T iron or angle iron is riveted, to prevent the springing of the plates under the pressure; and at distance of 4 or 5 feet small rollers are placed, so that, should the pressure be sufficient to spring the sides of the gas-holder, these rollers would come in contact with the outside plates, and prevent the gas-holder from catching in any way upon the plates or rivets. In the water spaces round the gas-holder and over the top of the tank strips of light angle iron are placed, to act as breakwaters, and prevent any oscillating motion being imparted to the water; and a strip of strong leather is fastened round the top of the outside sheeting, against which the sides of the gas-holder work, for the purpose of preventing any pieces of coke from getting into the water space. Through the centre of the water tank passes a gas-pipe, which extends 12 inches above the top of the tank, so as to prevent any water getting into it; and upon the gas-holder is a small dome, fitting over the pipe. This central pipe branches off below the tank to each side of the tender, where a coupling or union joint is fastened on the ends, for the purpose of coupling on to the pipe of the stationary gasometer. A small gas-pipe branches off from the central pipe to the coupling apparatus at the back of the tender, and so on for the supply of gas to the carriages.

A gas-holder, such as above described, 10 feet long, 7 feet wide, and 3 feet 6 inches deep, will contain 216 cubic feet of gas, allowing the bottom of the gas-holder to be 5 inches below the level of the water when full of gas, which is a necessary allowance for motion of the water or the difference of level of the two ends caused by steep gradients. The consumption of an average-sized burner being 3 cubic feet per hour, a train of 12 carriages, burning 2 lights each, gives 24 lights, consuming 3 cubic feet per hour each, or 72 cubic feet total,—making a consumption of 216 cubic feet in 3 hours; so that this gas-holder wil supply 12 carriages for 3 hours. The process of filling the gas-holder is simple:—At the principal stations along the line, at distances of from 50 to 100 miles, as circumstances may admit, there are small supply gasometers, from 8 to 12 feet diameter, which work at a pressure of from 12 to 24 inches of water: when a tender gas-holder requires filling, a branch of the central pipe is coupled by means of a union joint to the supply gasometer; and the pressure, being from 8 to 20 ins. greater in the gasometer than in the tender gas-holder, raises the latter, and fills it in from 1 to 2 minutes. As it was anticipated that the motion of the train would have the effect of giving the gas-holder a

jumping motion between its guides, owing to the elastic character of the gas, it was thought necessary to guard against this by inserting a rack in each guide-rod, and fixing a spring catch upon the top corners of the gas-holder, which, after catching the teeth of the rack, prevented the gas-holder from rising. However, in making the practical experiments with the gas-holder, this provision proved to be useless, the gas-holder working comparatively steadily, and having no tendency to rise more than $\frac{1}{8}$ inch. The result of this slight motion upon the flame was evident, in some instances drawing the gas back from the burner, and consequently extinguishing the light. These shocks, which are instantaneous, are now remedied by the simple arrangement of placing a small back flap-valve at the junction of the leading-off pipe with the gas-holder, which valve remains open so long as the gas enters the pipe from the gas-holder, but closes whenever the gas-holder has a tendency to draw the gas back from the pipe. The working of the valve has but a very slight effect upon the pressure in the pipes, the action being so rapid; and the effect upon the flame could not be detected when this plan was adopted. There is an advantage in adapting the gas-holder to the guard's van at the present time, even supposing the interior could not be made available for luggage, from the impracticability of altering the tenders made upon the present system, and from the guard's van, for a passenger train, not being in many instances of sufficient weight in itself as a break van, and requiring the addition of a considerable weight of iron to make an efficient break; in place of which dead weight the gas-holder will give all this advantage, the weight of a gas-holder, 10 feet long, being about $1\frac{1}{2}$ tons, including the water requisite for its working. Also, when running at the end of the train, the tail light, which is the most important, will be upon the same carriage as the gas-holder, and supplied by an independent pipe, which will preclude the possibility of its getting out of order.

The satisfactory working of the above arrangement of gas-holder has been practically ascertained by trial upon different lines, where it has been severely tested by being placed upon uneasy working trucks, which were found to have no effect upon its action.

A supply gasometer, of simple construction and small expense, was then required for charging the train gas-holders. For this purpose there was provided a small circular gasometer, 12 ft. diameter and 8 ft. high, containing about 900 cubic ft. of gas, sufficient to supply 2 or 3 train gas-holders without being filled from the gas works. It was balanced with weights running over pulleys in the ordinary manner. As the pressure requisite for filling the train gas-holders is from 12 to 24 inches of water, and the ordinary pressure at gas works only from 2 to 3 inches, the extra pressure in the gasometer was obtained by water on the roof. In order to fill the gasometer with gas, the water is all run off the roof by opening a cock, and the gasometer, being balanced by weights, rises with the gas works' pressure, the gas being admitted by a central pipe, through a self-acting gas-valve. As the gasometer rises, the lever of the water-discharge-cock, comes in contact with a projecting catch, which shuts the cock; and the gasometer rising to the top

of its guides, a projection on the gasometer comes in contact with a balance lever, which opens a water valve, and lets water on to the roof of the gasometer through a vertical pipe. When sufficient water has been let on the roof to give the required pressure, the gas is compressed by the gasometer falling a certain distance, and a second projection, depressing the balance lever, shuts the water valve; the gasometer is then ready to supply the train gas-holders with gas.

The self-acting gas-valve used, rises and falls with the slightest difference of pressure between the gas in the gasometer and that in the gas-works' pipe. The seating of the valve is formed of two circular ribs cast round the entrance orifice for the gas, and forming an annular cup to receive mercury ¾ inch in depth. The outer rib is carried up, to serve as a guide for the valve to work in. The valve is formed of thin sheet iron, and is balanced by a weight at the opposite end of the beam which carries it. When the pressure is equal above and below the valve, it merely touches the surface of the mercury; but when the water is let on to the top of the gasometer, the pressure in the gasometer sinks the valve, and causes the mercury to rise according to the pressure. This form of valve is self-acting in every respect, and must be perfectly tight, no leakage being possible; the only communication being through the mercury, when the valve is down.

The coupling between the carriages is effected by vulcanized india rubber tubing, with a cut-off apparatus fastened upon each end of every carriage. It consists of a short cut-off pipe, working upon a stopper, similar to an ordinary cock; the india rubber tube is attached to the pipe by a union joint. When the cut-off pipe is down against the side of the carriage, the hole in the pipe coincides with that in the stopper, leaving a clear passage for the gas: in this position, the cut-off pipe is held by a spring, which clasps it close above the union joint; and the joint is protected and closed in by two projecting wings. In uncoupling the carriages, before disengaging them, the porter pulls the india rubber tube, and thereby brings the cut-off pipe into a raised position, when the gas is cut off, and the pipe is held up by the spring catch, which prevents it from falling back, enabling the porter to unscrew the union joint. The india rubber tube is attached to the carriage by a chain, and, when disconnected, is hung upon a hook on the carriage: a tube is provided at each end of every carriage. In coupling together the carriages, after the carriage coupling has been screwed up, the india rubber tube is attached to the cut-off pipe, by the union joint, which requires three turns, and the pipe is then released from the spring-catch, and pushed down to position, thus turning on the gas to the carriage. The whole time taken up in either case should not exceed a quarter of a minute. In the event of one carriage becoming accidentally detached from the next, in consequence of breakage of the carriage coupling or otherwise, the strain thrown upon the india rubber tube will pull the cut-off pipe into the horizontal position, before the tube breaks, thereby cutting off the gas; and this coupling accordingly prevents any possibility of a carriage being detached from a train without cutting off the communication with the gas-holder.

The pipe supplying the burners in each carriage may run under the floor, or along the roof, as is most convenient. When a carriage is detached from the gas-holder, as in shunting at junctions, the lights in the carriage are prevented from going out by means of a small india rubber supply bag, about the size of an ordinary air-pillow, which is placed under one of the seats of the carriage, and connected to the gas-pipe supplying the burners. When the pressure of gas in the pipe is reduced to 1 inch of water, the supply bag begins to collapse, supplying the burners until the carriage is again attached to a train; the bag, containing about 1 cubic foot of gas, would be sufficient to keep the two burners in each carriage supplied for about half an hour.

The comparative cost of gas and oil for lighting railway trains remains now to be considered.

The actual cost of lighting a train of 12 carriages with oil lamps, while running 100 miles, amounts to about 9*s*. 6*d*., or 1·14*d*. per train per mile. With carriages burning gas, having 2 lights each, each burner consuming 4 cubic ft. of gas per hour, assuming 4 hours as the time taken in running 100 miles, the amount consumed in running 100 miles would be 384 cubic feet; and allowing 5 cubic feet per hour for the tail lamp, and 4 cubic feet per hour for each of the two side lights (making 52 cubic feet in 4 hours), the total consumption would be 436 cubic feet for a train of 12 carriages running 100 miles. Taking the cost of gas at 4*s*. per thousand cubic feet, which is the average cost throughout England, the total cost will amount to 1*s*. 9*d*. in running 100 miles, or 0·21*d*. per train per mile, as compared with 1·14*d*. per train per mile, the cost of oil lamps.

If a train of 12 carriages, burning gas, runs 100 miles per day on an average throughout the year, the cost of gas at the end of the year would be £31 18*s*. 9*d*., allowing 4 cubic feet of gas per hour to be consumed by each burner, which is 25 per cent. more than should be burned, thus allowing for loss and waste. For the same train burning oil, and running on an average 100 miles per day throughout the year as before, the sum would amount at the end of the year, to £173 7*s*. 6*d*., showing a saving in expense during the year, for a train of 12 carriages, of £141 8*s*. 9*d*. If a railway company run 10 trains, of 12 carriages each, 100 miles per day, on an average throughout the year, the cost of lighting would amount to £1733 when burning oil, and to £319 when burning gas, showing a clear saving with gas, of £1414 in the year, after allowing 25 per cent. for leakage or waste. The power of turning off the gas from unoccupied carriages, and from trains standing at stations, previous to starting and after arriving, would, at a fair calculation, give 15 or 20 per cent. of further saving to be added to the above.

The cost of 10 train gas-holders, at £30 each, would be £300; and assuming a railway company to have 300 miles of road, requiring a small supply gasometer for filling the train gas-holders at distances of about 60 miles, 6 gasometers would be necessary in this case, at £40 each, making £240 total; and taking the coupling apparatus, pipes, supply bags, and glass shades, at £3 for each carriage, for 120 carriages, the cost would be £360. The total cost, therefore, of fitting up

a railway 300 miles long, and having 120 carriages, reckoning 10 train gas-holders, and 6 supply gasometers, would be £900. This, taken from £1414, leaves to a railway company, after fitting up their line and carriages complete, a sum £514 clear, after paying all expenses for the year; and as the outlay for keeping the apparatus in repair would be small, the saving by the use of gas would afterwards amount to about £1400 per annum, in the case of 10 trains as above taken.

The comparative cost of lighting railway trains with gas, is much more as here taken than would be found in actual practice, since there are so many additional expenses connected with the oil lamp arrangement, as at present worked, which cannot be ascertained satisfactorily, to make the statement of the cost of oil complete.

Proceedings Inst. Mechanical Engineers, London.

AMERICAN PATENTS.

List of American Patents which issued from July 6 to July 27, 1858, (inclusive,) with Exemplifications.

JULY 6.

1. Machine for Cutting Corks; Robert P. Abernethey, Assigned to Union Cork Manufacturing Co., Cincinnati, Ohio.

Claim—1st, In this connexion, the automatic feed rest. 2d, Imparting to the mandrels of a cork cutting machine a compound rotary and vibratory movement, by means as set forth.

2. Machine for Cutting Corks; Robert P. Abernethey and Mahlon M. Wombaugh, Cincinnati, Ohio.

Claim—1st, The rotary cutter head, having alternate blades and spaces, in combination with the automatic mandrels, to admit of the removal of the finished cork, and clamping the fresh blank without removing either cutter or mandrels. 2d, In combination with the intermittent cutting disk and mandrels, the arrangement of half wheel cam movement and the accessories. 3d, In this connexion the feed apparatus, consisting of the hopper, notched piston, and cam movement, with their accessories. 4th, In the described connexion with the feed piston and mandrels, the spring pressure plate or finger, operated substantially as set forth. 5th, In the combination with the feed piston and mandrels, the discharging spring or strip.

3. Machines for Raking and Loading Hay; John B. Benton, J. F. Behn, and Gottlob Bastian, Buffalo, N. Y.

Claim—The combination of the bands, plate, and forks, the whole being constructed for operation conjointly, as set forth.

4. Sewing Machines; Robert M. Berry, City of New York.

Claim—Lifting the feed slide from the cloth, as described, by the double trip lever, the trip slide, and the trip spur, or their equivalents.

5. Machines for Gathering Stones; G. W. Bishop, Brooklyn, New York.

Claim—The box provided with the inclined plane, and used in connexion with the reciprocating scraper and spring guides, or their equivalents.

6. Sewing Machines; Lyman R. Blake, South Abington, Massachusetts.

Claim—The arrangement of the rest of a sewing mechanism, or combining it with an auxiliary arm of such form as to be capable of entering a shoe and introducing the rest into the toe, as well as other parts of the interior of the shoe, in order that an outer sole may be stitched or sewed upon the inner sole and upper of a shoe. Also, arranging either the thread passage or looper, or both, within, or so as to operate with the auxiliary arm.

7. Breech-loading Fire Arm; Enoch Brooks and George Walker, Philadelphia, Pennsylvania.

Claim—1st, The attachment of the hammer to an arm having a curved back, to which the main spring is applied. 2d, The arrangement of the cocking lever, the sere, and trigger, as applied in combination with the main spring and hammer arm. 3d, Combining the cocking lever with the breech, by means of a slider, rod, and wrist pin, applied as described, to cock the lock by the movement given to the breech to permit the loading.

8. Railroad Car Seats and Berths; Zenas Cobb, Chicago, Illinois.

Claim—1st, Arranging the lower portion and hinged backs of the seats on the rail and ledges, so as to either enable them to be used as a double sleeping couch, or as a seat, in the manner described. 2d, The arrangement of the cushioned frames or platforms above the seats, and jointing them to the uprights of the partitions and sides of the car, and providing them with lugs, and the sides of the car and the movable bar with swinging hooks or lugs for forming the upper double berth when desired.

9. Stopper for Bottles; Munson C. Cronk, Auburn, New York.

Claim—Attaching to the necks of bottles and within a tapering space, a tapering or flaring tube, having

a concentric cylindrical tube cast or secured around the same with a cap screwed on its top, and an outlet tube attached to its sides.

10. Method of Attaching Lamps to Lanterns; John Fleming, Pittsburgh, Pennsylvania.

Claim—The combination of the spring, D, with the clips, E E, and the ring, F, for the purpose of effecting the attachment and detachment at the lamp of a lantern.

11. Boring Machine; L. A. Dole, Salem, Ohio.

Claim—1st, The combination of two drill stocks, by means of an internally geared driving wheel and a small pinion, so that a slow or fast speed drill or auger may be used at pleasure, as the necessity of the case may require, in the same machine, and by the turning of one and the same crank. 2d, Effecting the combination of both of said drill stocks, with the feeding rack bar and the two segment levers, by means of a flanch on the rear end of the rack bar, and collars on the drill stocks, so that both shall be fed up together.

12. Machine for Upsetting Carriage Axles; Zina Doolittle, Perry, Georgia.

Claim—1st, The arrangement of the centre bar or anvil, pivoted jaws, and eccentric levers, in the relation to one another shown. 2d, The combination with the above of eccentric clutches, dies, springs, and slides.

13. Corn Planters; Warren Drummond, Woodbridge, New Jersey.

Claim—The particular manner described of arranging and combining for united use only the two dropping slides, double-acting cut-off plate, double crank axle, covering rollers, combined brace and scraper, adjustable furrow-opening and closing tubes or shares, and secondary hopper.

14. Steam Engines; John Ericsson, City of New York.

Claim—The arrangement of the two cylinders in such manner that their base or bottom ranges with a plane which passes through the axis of the propeller shaft, or nearly so, in combination with a system of rock shafts, crank levers, and connecting rods, so proportioned, applied, and arranged that the use of a driving crank on the propeller shaft, of greater length than half the stroke of the piston, is permitted, and that the connecting rods will operate nearly at right angles to each other, and will be in a line with each other at the termination of each stroke of either piston.

15. Pump; Gilbert B. Farnum, Meriden, Connecticut.

Claim—The use of the thimble, cap, and guide rod, having a re-acting spring attached to its upper end, and confined within the air-tight thimble, in combination with the valve and elastic diaphragm, for the purpose of lifting and dropping said valve squarely from and to its seat, and at the same time protecting the guide rod and re-acting spring attached thereto, from the rust of the liquids acted upon by the pump.

16. Mills for Cutting, Crushing, and Expressing the Juice from Sugar Cane; John J. Fearrington, Pittsborough, North Carolina.

Claim—In combination with the cutter and the dressing rollers, the guiding trunk and dividing board, the whole being arranged for cutting, conducting to the pressers, and pressing and separating the spent cane from the juices.

17. Registering Attachment for Clocks; Stanislas Fournier, New Orleans, Louisiana.

Claim—1st, In combination with the clock, the wheel, C, by which I give motion to the wheel, D, that moves the rack, F, for a portion of the twenty-four hours; this I claim when either using the wheel, D, and the rack, F, as set forth, or any other analogous mode by which the apparatus can be made to register substantially the same, as regards the time specified. 2d, The carriage, K, in combination with the rack, F, when the action of the clock, through the use of the rack, or its equivalent, gives motion to the carriage, and holds the index bar, M, over the card, ready to have the time indicated.

18. Pumps; A. A. Genung, Painesville, Ohio.

Claim—Forming the plunger rod in two separate and distinct parts, and constructing said parts with the barbs and raised surface, also the form and location of the guides, as specified, or their equivalents, by which said arrangement of parts, in combination with the motion of the wind wheel, I am enabled to apply the connecting and disconnecting principle to the plunger.

19. Faucets; Henry Getty, Brooklyn, New York.

Claim—1st, The cylinders and slots, in combination with the arm on the valve stem, and the inclines, for the purposes specified. 2d, The suction pipe between the point of leakage or overflow at the spindle rod or valve stem and the delivery pipe, when said pipe is in such a position to the discharging liquid that the rush of said liquid past its end shall augment the speed of the liquid in said pipe, and draw away any leakage, as specified. 3d, The air tube of thin sheet metal, or equivalent material, inserted into the shell of the faucet. And in combination with said tube, I claim the self-acting air valve on the cock.

20. Machine for Turning the Heads and for Nicking Screws; Ira Griggs, Assignor to the Utica Screw Manufacturing Co., Utica, New York.

Claim—1st, The arrangement of a series of rotating blank holders in bearings, at equal distances apart, in and at equal distances from the centre of a stock, which has an intermittent rotary motion, for the purpose of presenting each of the series in succession to the feed apparatus, to the cutter for turning the heads to the saw, for cutting the notches, and to a cutter for finishing the heads after the notches have been cut. 2d, The relative arrangement of the driving shaft, the blank holders and their rotating stock, the turning cutters and the saw for cutting the notches, whereby, when the blank holders severally arrive opposite the saw, the driving belt which gives them the rotary motion on their axis to effect the turning, is inoperative upon them. 3d, The series of movable rests, applied and operating substantially as described, to support the screw blanks, and hold them steady during the operation of the cutters and saw. 4th, Combining the holding dies with their operating levers, by making the said dies detached from their levers, and fitting them to slide within guides in the holder, and applying adjusting screws to the levers at their bearing upon the dies. 5th, Applying the discharging punches of the blank holders with springs to retract them within the holders after the discharge of the blanks, and in such manner that the plungers, after opening the holding dies or jaws, will drive them forward to expel the blanks.

21. Ploughs; I. P. Harris, Byhalia, Mississippi.

Claim—The hollow foot, formed and arranged for the reception of the stock, substantially as specified.

22. Washing Machine; R. H. Harrison, Laurel, Maryland.

Claim—The construction of a washing machine having a concave bottom, with a secondary grating-like or fluted bottom, the slotted rocking lever, and the corrugated balls, or their equivalents.

23. Machines for Testing the Strength of Springs; S. H. Hartman, Pittsburgh, Pennsylvania.

Claim—1st, The application of steam through mechanical appliances to the compressing springs, with a

view of testing their temper or strength. 2d, In combination with steam, applied as stated, for compressing the spring to ascertain its temper or strength, the application of a steam indicator for showing in pounds weight, or otherwise, the amount of pressure applied.

24. CHAIRS FOR RAILWAYS; Wm. Hall, Springfield, Massachusetts.

Claim—The mode described for securing the ends of rails.

25. LATHES FOR TURNING IN METALS; George Henderson and Jacob Steele, Allegheny, Pennsylvania.

Claim—The combination of the two chucks with a lathe.

26. RUNNING GEAR OF WAGONS; Jonathan Hibbs, Tullytown, Pennsylvania.

Claim—The method described of operating both the axles of a wagon in turning curves, namely, by means of the curved rack affixed to each axle, in combination with the connecting pinion.

27. ROTARY PUMP; A. P. Holly, Seneca Falls, New York.

Claim—A rotary pump provided with eccentric cylinders, having concentric portions and corresponding depressions, and operating within the compartments of the case, substantially in the manner specified.

28. METHOD OF CONSTRUCTING IRON RAILINGS; Luther Homes, New Orleans, Louisiana.

Claim—Securing and embracing the circular projections at the upper and lower ends of the upright bars, within the horizontal tubular rails formed by the semi-circular and straight bars, and the portions of said bars next the flat circular parts between the notches in the bridge plates and the left hand ends of the notches or depressions in the edges of the bar, and the right hand ends of the corresponding notches or depressions in the edges of the bars, by means of the interlocking pins, and pins or lugs, and hubs or blocks.

29. CULTIVATORS; Duncan E Hubbard, Okolona, Mississippi.

Claim—The combination of share, stock, and tooth, the whole being arranged as set forth.

30. MEASURING FAUCET; Gilbert Hubbard, Montville, Massachusetts.

Claim—The combination of the passages, with the rotating cylinders provided with followers connected by the lever, and operated through the medium gearing, pawl, nichet, and spring, the above parts being used in connexion with the cut-off, arranged with the nut and levers, or other equivalent device, whereby the cut-off may be closed automatically and simultaneously with the cessation of the rotation of the cylinders.

31. ROTATING SHAFTS WITHOUT USING A CRANK; Simon Ingersoll, Greenwich, Connecticut.

Claim—The lever with its slide, or its equivalent, when arranged in the manner set forth.

32. SKIRT HOOPS; Austin Kelley, City of New York.

Claim—Combining and arranging two hoop skirts together in the manner set forth, the inner skirt being adjustable for the purpose of forming a bustle when contracted, and for an additional support to the outer skirt when expanded.

33. STEAM BOILERS; A. R. Ketcham, Buffalo, New York.

Claim—The construction and arrangement of the interior fire chamber relatively to the furnaces and the registers, for the purposes set forth.

34. CHURNS; James Macnish, Berlin, Wisconsin.

Claim—Effecting the breakage of the globules or sacks which contain the fatty particles of the milk or cream by the combined forces of compression and friction, employing for producing these forces a roller, in combination with a stationary concave, the roller revolving within and coming in contact with said concave.

35. CHURNS; James Macnish, Berlin, Wisconsin.

Claim—The combination of the inner set of tangentially set spring wings with the outer set of wings, as set forth. Also, the combination of the friction plates, H J, with the two sets of spring wings, and the churn tub.

36. DUST PAN; Thomas E. McNeill, Philadelphia, Pennsylvania.

Claim—Constructing the dust pan with a dust receptacle or box and an inclined surface.

37. RAKING AND BINDING ATTACHMENT TO HARVESTERS; John P. Manny, Rockford, Illinois.

Claim—In combination with a reaping machine, a rake that automatically throws itself out of gear when it arrives at the outer or grain end of the platform, in the manner described. Also, combining with a rake that automatically throws itself out of gear, and a gathering apparatus, a mechanism by which the driver from his seat, or the attendant at his stand on the machine, can throw said rake into action when desired. Also, in combination with a rake and the gathering apparatus to form the gavel, the bent arm, provided with the points for the purpose of holding one end of the band that is to fasten the gavel when gathered. Also, the bent lever with its forked head, which, when operated as above described, shall carry the band between its prongs, and which, when released, shall be driven back by the spring releasing the band, the hook of which shall then be driven into the band by the expansion of the gavel. Also, operating the lever by means of the coiled spring, for the purpose of adjusting the motion of said lever, so as to bind large and small bundles equally tight.

38. HARVESTERS; John P. Manny, Rockford, Illinois.

Claim—In combination with a main frame supported in a fixed position, that is, parallel with the surface of the ground at all times, and a finger bar attached thereto, and operated as described, one arm of the said frame extended sufficiently to the rear to project over or behind the finger bar of the machine; and this I claim, whether the caster wheel be in front of, or behind, the driving wheel.

39. TRACK CLEARERS FOR HARVESTERS; John P. Manny, Rockford, Illinois.

Claim—A wing board or track clearer, which is hinged to the divider and composed of two or more parts which are hinged together, and which may be adjusted together or independently of each other.

40. HARVESTER FINGERS; John P. Manny, Rockford, Illinois.

Claim—Tapering the face of the guard finger under the sickle bar, and to the rear thereof to a point, and forming a cavity under and behind said point.

41. MODE OF SECURING GRAIN IN BUNDLES OR SHEAVES; John P. Manny, Rockford, Illinois.

Cilam—The use of a short band cut in suitable lengths for separate bundles, placed in proper position by hand, and automatically passed around the bundle and fastened by the expansion of the bundle when released.

42. BURGLARS' ALARM CLOCK; John Matheuman, New Haven, Connecticut.

Claim—1st, The application to the lamp, of the revolving emery paper cylinder, operated as described.

2d, The combination of the frame having duplicated brackets, with the tube, match holder, and lamp. 3d, Connecting the lighting apparatus with an alarm clock, so as to operate either by the opening of the door or window of the room, or by the clock. 4th, The combination of the detaching lever, c, with the lever, B, and tongue, E, and their connecting wires, so that the lighting apparatus, and, if desired, the alarms, can be operated from a distant point.

43. HILLSIDE PLOUGHS; Modest Merk, Rochester, New York.

Claim—The reversible convex winged colter share, constructed in combination with the plane subsidiary mould-board, connecting arm, and furrow bar

44. HARVESTERS; Jeremiah Mitchell, Gosport, New York.

Claim—Combining with the cutter bar of a harvesting machine, in the manner described, the tilting jack, constructed as described, that is to say, having the revolving handle, spring chuck, stationary catch plate, pinion, and rack bar, in combination with the wheel, C, these several parts being constructed and relatively arranged with respect to each other, and to the cutter bar.

45. MACHINE FOR PARING, SLICING, AND CORING APPLES; J. J. Parker, Marietta, Ohio.

Claim—The combination of the stationary screw, slicing and paring knives, by which the apples are fed and revolved. Also, feeding the apples past the paring knife to the sliding device, by giving the apples a rotating motion, and using a stationary screw, the screw slicing device and paring knife being arranged relatively with each other, as specified.

46. SAUSAGE FILLER; John G. Perry, South Kingston, Rhode Island.

Claim—The combination of the tube or nozzle with the curved cylinder, for the purposes set forth.

47. MACHINE FOR STUFFING HORSE COLLARS; Levi Plonk, Newton, North Carolina.

Claim—The straw conveyers, in combination with the loose sliding frame, for the purpose of carrying the straw to the feed rod. Also, the elastic blades in combination with the guards, for the purpose of guiding the straw to the funnel.

48. RAILROAD CAR COUPLINGS; J. H. Quackenbush, Owasso, Michigan.

I am aware that various forms of self-couplings have been devised, and I do not claim separately any of the parts, irrespective of their construction, arrangement, and relative position, as described, whereby the device is not only rendered self-coupling, but is also rendered susceptible of being detached from within the cars, and the cars also if thrown from the track made to disconnect themselves. I claim therefore as new,

Claim—The lever, formed of two bars fitted in the head or socket, provided with a pendent connected with the pin or bolt, and having the chains attached to it, the whole being combined and arranged as set forth.

49. VENTILATING MILL STONES; L. Racine, Joliet, Illinois.

Claim—The arrangement and combination of the blast pipe, curb, flanch, rim, flexible bottom, tube, and exhaust pipe, as set forth.

50. MACHINE FOR LEATHERING TACKS; Jesse Reed, Marshfield, Massachusetts.

Claim—1st, Driving the tacks and cutting out the piece of leather by a solid punch, operating as set forth. 2d, The nippers, in combination with the rest and tube, operating as described.

51. ATTACHING CARRIAGE SPRINGS; Luther Otway Rice, Berlin, Canada West.

Claim—Placing the scroll spring divergent to the axle, and supporting the same on the axle by means of the clip at the end thereof, and the raised double clip, or equivalent, near the wheel.

52. MACHINE FOR LEATHERING TACKS; Charles L. Russell, Derby, Connecticut.

Claim—1st, One or more separators leaving a cavity in their ends, or an equivalent therefor, which shall grasp the head or body of the tack, or both. 2d, The fingers, arranged in the relation shown to the tube or guide, and working alternately, so that one serves as a stop to the tack and the other as a discharger thereof, in such a manner as to ensure the dropping of the tack into the tube or guide with unerring certainty at the precise time and place necessary. 3d, The fork, or its equivalent, when working through or across a tube near its top, as shown, for the purpose of ensuring the dropping of the tacks perpendicularly into the tube. 4th, The guide or conducting tube, having inclined or horizontal passages running into each other, in combination with the driving punch, cutting punch, die, race, and feed motion. 5th, The self-adjusting grooved rest or guide, for receiving and supporting the point of the tack, when arranged so that the tack shall be kept on the guide by its own weight. 6th, Feeding leather or other material to the machine in the operation of leathering tacks by each succeeding tack itself, which is driven into or through the material used for forming the heads or disks, and acts as a stop to a feed motion, whereby to effect the movement of the material to a position in front of the cutting punch.

53. SASH HOLDER; Eliphalet S. Scripture, New Haven, Connecticut.

Claim—The oscillating swivel cup, in combination with an elastic buffer, all being arranged as set forth.

54. COTTON CULTIVATORS; Asberry Smith, Ashville, Alabama.

Claim—The arrangement of the upright, brace, beam, and support, so that a plane will pass through or near the whole of them, and when the wing is connected to, and projects from, the said upright.

55. ARRANGEMENT FOR DEVICES FOR PLANING MOULDINGS; Hezekiah B Smith, Lowell, Massachusetts.

Claim—The relative arrangement and combination of the spire feed wheel with the cutter head and table, they being adjustable with each other in the manner described.

56. BREECH-LOADING FIRE ARM; George H. Soule, Jersey City, New Jersey.

Claim—The peculiar construction and mode of operating the plunger, and securing it to its place while the gun is being discharged. Also, the brace and the connexion of the breech piece and the lever. Also, the cams as applied to raising the brace.

57. TAILORS' MEASURE; W. R. Stace, Rochester, New York.

Claim—The construction and use of an instrument for measuring and drafting garments, said instrument consisting of the graduated arcs or dial plates (A′ and B′), connected by the graduated arc (C′), said arc being expansible by means of slots, pins, and screws.

58. TREATMENT OF FIBRE OF TAMPICO HEMP; Werner Staufen, London, England.

Claim—Changing the properties of the fibres of the plant known as the "Argrave Americana," by first saturating said fibres with an alkaline solution, and then immediately submitting the same to the action of a high degree of artificial heat, substantially as herein described, and preparatory to using said fibres as a substitute for horse hair and bristles in the production of various useful articles.

59. CONTINUOUS CHAIR RAILS; Cornelius A. Stancliff and James Mingis, Williamsport, Pennsylvania.

Claim—The combination and arrangement of the part, A A', with the protected cushion and with the continuous chair, which latter is adapted to form two lines of continuous rigid supports, one under each side of the body or tread of the rail, whenever the elastic material is compressed to a certain extent.

60. NAIL MACHINE; Hiram W. Taylor, Birmingham, Pennsylvania.

Claim—1st, The use of a rocking journal box for the sleeve of the feeding rod, to permit of the elevation of the lower end of the feeding rod when the nail plate is turned, or when a full nail plate is to be inserted. 2d, The combination of the pivoted lever with the lugs, c', on the cog-wheel, and the inclined projection on the segmental cog-wheel, for the purpose of securing their gearing together in the correct relative situation. 3d, The use of a crab for connecting shafts, having one lug nearer the centre than the other, so that the inner lug of one-half of the crab will pass the outer lug on the other half without locking, for the purpose of causing them to gear always at the same relative point in their revolution. 4th, The use of a button or stop at the head of the feed rod, in combination with a lever, through the extremity of which the feed rod slides freely until the button or stop touches or presses forward the lever, for the purpose of disconnecting the feed apparatus from the nail machine automatically so soon as the nail plate is worked up. 5th, The use of the gripping jaws, constructed as described, in combination with the rest, K', and the spring, S 3, for the purpose of producing the requisite feed motion of the feed rod.

61. RICE HULLING MACHINES; John F. Taylor, Charleston, South Carolina.

Claim—The employment of the curved lever frame attached at one end to the bed piece, and having the pestle permanently secured to the opposite end, the above parts being placed relatively with the vessel, B, described and used in connexion with the geared eccentrics, arranged relatively with each other and the lever frame, as set forth.

62. CORN SHELLERS; P. P. Taft, Taftsville, Vermont.

Claim—The rotating toothed cylinder, in combination with two or more reciprocating toothed concaves moving simultaneously in opposite directions, the parts being arranged within a suitable box, case, or framing, and operated as set forth.

63. TRUNK PROTECTOR; R. M. Wade, Wadesville, Virginia.

Claim—The skeleton trunk casing made up of wooden strips with bent extremities, connected with straps and attached to the trunk.

64. MACHINES FOR HULLING RICE; R. P. Walker, City of New York.

Claim—1st, A surface of emery, in combination with an india rubber or other elastic surface for hulling rice or other grain, when motion is communicated to one or both of said surfaces, in such a manner that the surface of emery abrades the hulls for removing the same, as the rice or other grain is partially imbedded or retained by the said elastic surface. 2d, Imparting an endwise motion to an elastic roller, or its equivalent, in combination with a revolving roughened surface, when the same is used for the purpose of hulling rice or other grains.

65. EAR, CHEEK, AND CHIN MUFF; W. P. Ware, Cincinnati, Ohio.

Claim—The arrangement of the ear, cheek, and chin pieces, constructed and joined together in the manner represented.

66. STEAM ALARM AND SAFETY APPARATUS; S. W. Warren, Brooklyn, New York.

I do not claim the expanding tube nor any of the parts that have heretofore been used in boiler alarms.

Claim—The arrangement and combination, as shown and described, of the arched or curved spring, valve, and tube.

67. FURNACES; B. H. Washington, Hannibal, Missouri.

Claim—The air conductors placed below the grate bars, constructed as shown, and used in connexion with the cones or funnels, as set forth.

68. MACHINERY FOR PRESSING STRAW BONNETS AND OTHER ARTICLES OF VARYING THICKNESS; H. E West, Norton, Massachusetts.

Claim—A mould either hot or cold to form the article pressed, in combination with a flexible presser operated by a fluid substance, either liquid or gaseous, so as to press the article or substance to be shaped or moulded into the mould, and give it the form or shape required. Also, the use of cold water or other cold liquid to operate the flexible presser, in combination with a hot mould, so that the cold flexible presser will condense the moisture evaporated or driven from the article pressed by the hot mould, and leave said article nearly or quite dry. Also, the process of shaping bonnets, hats, or other articles, by pressing them into, or on to, a mould, either hot or cold, by means of a flexible presser, operated by some liquid or gaseous substance.

69. MAKING PAPER BAGS; Francis Wolle, Bethlehem, Pennsylvania.

Claim—1st, The combination of the creaser, C, and lapper, F G, arranged in the manner set forth. 2d, The revolving lapper shaft, U, in combination with the creaser, V S, the feed roller and aprons, as described, the creaser being brought into operation on the bags during the intermission in the motion of the feed rollers.

70. BEDSTEAD FASTENINGS; E. S. Wright, Buffalo, New York.

Claim—The combination of the coupling hook, wedge, and pin, arranged in the manner set forth.

71. FURNACES FOR STEAM BOILERS; Henry Yates, Brantford, Canada.

Claim—1st, The perforated metal cone, in combination with the tight furnace bottom, operating in the manner set forth. 2d, And in combination with the above, the damper, operating as set forth. 3d, the water heater, in combination with the perforated metallic cone and damper, arranged in the manner specified.

72. RAILROAD BRIDGE SIGNALIZER; Amos Burnham, Assignor to self and J. M. Cook, Taunton, Massachusetts.

Claim—A series of pendants and an arrangement of such as described, each pendant being of such weight as not to be capable of being so affected by ordinary aerial currents produced by a railway train, or otherwise, as to be readily blown out of the way of a person on the top of a car or train or the load thereof, while such may be passing under it, but still of a weight not capable of doing or causing material injury to such person under such circumstances, and each pendant being arranged at such distance from that or those next to it as to ensure contact with some one or more of them by a person when on the roof or load of a car, and being carried under them, and situated at such an elevation as not to be in danger of injury from a bridge or obstacle toward which the train or car may be advancing.

73. STOPPER FOR BOTTLES; James Ewing, Assignor to F. V. Rushton, City of New York.

Claim—As an improvement in bottle stoppers for bottles containing gaseous liquids confined under high pressure, is the arrangement of the tubular stem valve, B, within the chest, A, with the cork tube, E.

74. WATER METRE; Wm. Darker, Jr., Assignor to J. B. Thompson, Philadelphia, Pennsylvania.

Claim—The combination and arrangement of the eccentric cams, G G′, angular rods, H H′, attached to the valve, K, and curved springs, E E′, and friction rollers, F F′, on the sides of the piston, A, for giving the required reciprocating movement to the valve.

75. HORSE HAY RAKES; John F. Faust, Lebanon, Ohio, Assignor to self and R. M. Ross, Philadelphia, Penna.

Claim—The combined arrangement of the arms, A′ A′, rods, B B, arms, E E, K K, and guide rod, A A, as constructed and arranged with the rake, H, and carriage, for operating the rake in the manner set forth.

76. VALVE REGULATORS; William S. Gale, Assignor to self, Alfred A. Valentine, and W. H. Butler, City of New York.

Claim—In combination with the plane diaphragm, corresponding load piece, compound lever, and the support, the projections or ridges on the under surface of the load piece, and the printing of the shape of the same into the diaphragm, for the purpose of preventing the slipping of C, laterally upon B, as set forth.

77. PUNCH FOR PERFORATING METAL; Washington J. Granger, Assignor to D. J. Lake and C. B. Brown, Chicago, Illinois.

Claim—The arrangement of a punch with a series of slides accurately fitting both punch and tube, and retained in their places by springs, or their equivalents, for affording a lateral support to enable the punch to withstand strain while operating.

78. PRESSURE GAUGE; Wm. C. Grimes, Assignor to David Matthew, Philadelphia, Pennsylvania.

Claim—The manner of constructing and arranging the concentric glasses and connecting tubes, as set forth.

79. PRESSURE GAUGE; Wm. C. Grimes, Assignor to David Matthew, Philadelphia, Pennsylvania.

Claim—The peculiar construction of mercurial pressure gauge, having two concentric glass tubes, so proportioned to each other and the reading scale as to produce the necessary space to register the units and tens, and make them more uniform and legible.

80. CORN HUSKER; Leonard A Grover, Roxbury, Assignor to self and N. T. Spear, Boston, Massachusetts.

Claim—The rotating toothed cone, plates, B, or boards, D D, one being provided with teeth, in combination with the tilting bed or hopper, and the vibrating knife and stationary knife.

81. LOCK; John Philip Lipps, Newark, New Jersey, Assignor to George D. Baldwin, City of New York.

Claim—The independent bit, constructed as shown, and held anteriorly or above the bolt by the horizontal spring (and independent of the spiral springs), thereby securing against the introduction of any instrument to pick the lock.

82. MAGNETIC STEAM GAUGE; Joshua Lowe, City of New York, Assignor to self and Daniel Barnum, Jersey City, New Jersey.

Claim—The construction of a polar magnet with one arm or pole larger than the other, so that the enlarged pole will float on the surface of the mercury, whether the lesser pole be immersed or not, whenever the said magnet is placed within a chamber filled or partially filled with mercury, and hung on pivots in the centre, thus making a self-adjusting movable magnet, capable of being used as a floating magnet within a small tight chamber. Also, the combination of a floating magnet, a magnetic needle, and a dial or index plate, forming one side of an isolated tight chamber, and with mercury and air within said chamber, or their equivalents, for the purpose of making a magnetic pressure gauge. Also, the combination of a floating magnet, a magnetic needle, and a dial or index plate, forming one side of an isolated tight chamber, and with mercury or other fluid within said chamber, for the purpose of making a magnetic vacuum gauge.

83. BURGLARS' ALARM CLOCK; George D. Sargent, Boston, Assignor to self and Thomas R. Abbott, Malden, Massachusetts.

Claim—The combination of the lamp and its lighting apparatus with an alarm apparatus, its case and the door thereof, so as to be operated thereby, or to operate in connexion therewith. Also, arranging the lamp and the match carrier on the door of the case, in combination with applying the match grater to the stationary part or body of the case. Also, the combination for operating the extinguisher, the same consisting in the match grater, the spring lifter, the depresser, the catch, and the detacher.

84. FAUCET; N. P. Whittelsey, Assignor to James A. Frary, Meriden, Connecticut.

Claim—The adjustable gate, constructed in the form of a segment of a sphere, and fitted to the tube over a concave seat provided with a packing.

JULY 13.

85. KNITTING MACHINES; Nelson P. Aiken, Troy, New York.

Claim—The arrangement of the shipper or belt-shifter, in combination with the movable stop, lever, and sliding bar, when controlled by a sinker wheel, or by any wheel gearing with, and moved by, the needles.

86. SPOKE-SHAVE; Leonard Bailey, Winchester, Massachusetts.

Claim—The improved spoke-shave, as constructed, with its bearing surface in front of its cutter, applied to the stock by means of a lever having an adjusting screw, or its equivalent, or a screw and a spring applied to it, so as to enable the said bearing surface to be moved with respect to the cutter and the bearing surface in the rear thereof. Also, the arrangement and application of a protecting cavity or chamber within the lever, and to the spring thereof.

87. KETTLES FOR RENDERING LARD; John J. Bate, Brooklyn, New York.

Claim—Providing a means of communication between the exterior and interior of the heater by the apertures, D D′, so that the contents of the kettle and the heater can communicate with each other.

88. SPRING PULLEY FOR WINDOW SASHES; Dana Bickford, Westerly, Rhode Island.

Claim—The combination of the friction wheel, or its equivalent, and the bearings of the pulley with the lip in connexion with other parts of the spring balance.

89. MACHINES FOR CUTTING PAPER; Milton B. Bigelow, Boston, Massachusetts.

I do not confine myself to the precise mechanical devices described, as they are susceptible of various modifications. It is very obvious, for instance, that V-shaped rails might be employed for sustaining and directing the sliding carriage and cutting-board in their movements; also, that a short shaft with a crank and

pinion on it, might be attached to the frame, said pinion being made to engage in a gear wheel affixed to the rock shaft, o, for the purpose of moving the cutting-board and paper.

Claim—The described mechanism, or any other essentially the same, by means of which the cutting-board is prevented from moving in any other direction than a straight line, in its horizontal motions, said mechanism consisting of the guide rails and the sliding carriage. Also, actuating the sliding carriage and with it the cutting-board, by means of the mechanism described, or any other essentially the same, said mechanism consisting of the levers, the rock shaft, and the straight lever, connected and operating in the manner specified.

90. Door Plates; Jeremy W. Bliss, Hartford, Connecticut.

Claim—The perforated door plate bell arrangement, constructed and arranged to secure the three-fold object.

91. Machines for Hulling Rice; Joseph S. Bossard, Sumterville, South Carolina.

Claim—The employment or use of the arms attached radially to the rotating shafts in connexion with the projections on the pestle shafts.

92. Machines for Dressing Hides and Leather; John R. Bumgarner and Lyman White, Davenport, Iowa.

Claim—1st, The combination, by means of two carriages moving at right angles to each other, one having an intermittent longitudinal motion, and serving to feed the hides or skins to the action of the dressing frames, and the other having a transverse reciprocating motion, and serving to carry and move the dressing frames across the hides or skins. 2d, The peculiar manner of constructing the intermittent carriage in sections, and with long and short clamps, whereby hides or skins of different sizes can be clamped and distended on the same. 3d, The automatic device, specified, for clearing the knives just after the completion of their movement from one edge of the hide or skin to the other, of all matter which may have accumulated on them, and which would be likely to clog their action. 4th, The arrangement of the standards, set-screws, levers, cords, and windlass shaft. 5th, The combination of the windlass shaft with the dressing frame carriage, by means of the ratchet movement and the projection.

93. Propeller for Canal Boats; Abner Burbank, Buffalo, New York.

Claim—A propeller and shaft movable in a longitudinal direction, in combination with a rudder having a notch or recess therein, to receive the propeller.

94. Rocking Chair; Isaac P. Carrier, South Glasenbury, Connecticut.

Claim—The arrangement of the frame or arms, rod, springs, stud, and the pin and holes.

95. Machine for Cutting Barrel Heads; A. H. Crozier, Oswego, New York.

Claim—1st, The disk, M, constructed as described. 2d, The method described of connecting the saw and cutter, so that both are controlled by the same winch or lever. 3d, Attaching the saw to a sliding stock.

96. Bustles and Skirts; Handel N. Daggett, Attleboro', Massachusetts.

Claim—The improvement or combination of the back strut with the bustle or skirt and the adjusting lacing, such being applied and made to operate as specified.

97. Tool for Cutting Cylindrical or Tapering Sticks; George Davis, Duquesne, Pennsylvania.

Claim—The combination of the cylindrical stock, adjustable block, and bit, constructed for cutting round or tapered sticks for handles, &c.

98. Force Pumps for Fire Engines; John N. Dennisson, Newark, New Jersey.

Claim—Increasing the capacity of the pumps of fire engines near the end of the stroke, by the expedients described.

99. Clothes-Drying Apparatus; Olonzo R. Dinsmoor, Auburn, New Hampshire.

Claim—The combination of the endless clothes line, the sheltering shed or building, and the stretching apparatus. Also, combining one or more travelers with the endless clothes line applied to a building and a stretching apparatus.

100. Metallic Hub for Carriage Wheels; Nathaniel T. Edson, New Orleans, Louisiana.

Claim—1st, The cone, H, when made and applied in the manner specified. 2d, The oil chamber, in combination with one or more orifices, when formed on the outside of the box by means of a nut. 3d, The combination of the oil cup with the cone, for the purposes specified. 4th, The chamber, as described, in combination with the outer cup.

101. Sawing Machines; Henry Featherstone and Peter Engman, New Orleans, Louisiana.

Claim—1st, The lateral movement of the saw. 2d, The suspension guides with their cups and balls, as applied here, to guide the saw and its connexions with the saw shaft. 3d, The back-bone rack connecting the truck. 4th, The truck and dog with their movement, by means of the sector and rack.

102. Railroad Car Box Cases and Pedestals; Jacob C. Grisendorff, Cincinnati, Ohio.

Claim—The employment of the lugs formed on box case, when used in connexion with the notches (two or more), formed in the pedestal, for the purpose of readily detaching or removing the box from the axle, yet retaining the box case in a proper position in the jaws of the pedestal.

103. Washing Machine; B. F. Ghormley, New Frankford, Indiana.

Claim—The combination and arrangement of the fluted and grooved roller, B, and the cords and roller, C, with the hinged washboard, springs, and temper screws.

104. Traps for Animals; Samuel Gibson, Martic Township, Pennsylvania.

Claim—The chambered box, wire drop cage, and tilting bottom, when combined.

105. Printing Presses; George P. Gordon, City of New York.

Claim—1st, One or more sets of gripers or nippers, independent in themselves, which shall revolve upon their axes, and carry the sheet from its point of feeding to its place of deposit, whether operated in the precise manner described or in some equivalent way. 2d, The "stop," or its equivalent, for holding the said gripers, or their equivalent, in the desired position, for the purpose of insuring an exact and regular feeding, registering, and delivering of the sheet. 3d, One or more sets of gripers (which revolve upon their axes,) having a movable base, with fingers to close upon said base, and hold the sheet, whether constructed in this precise manner or in some equivalent way, to produce a like result. 4th, The combined action of said gripers and the vibrating springs, strips, or frisket, for the purpose of conveying the sheet to, and receiving and holding it in, the proper position for the reception of the impression, and insuring its proper delivery after it shall have been printed. 5th, The vibrating double cam for throwing off and on the impression. 6th, Two or more

distributing rollers, having a lateral motion upon a main distributor, which shall move independent of, and in opposite direction to, each other, and thus alternately cross and re-cross each other's distribution, for the purpose of giving an uniform inking. 7th, The relative arrangement of the feed table, the fly board, the platen, and the bed, in combination with the revolving gripers. 8th. The two distributions given to the inking rollers upon one cylinder for each impression (heretofore patented by me), in combination with the rotating reciprocating bed with its spring extension. 9th, The fly board with its adjustable ledge, in combination with the gripers, to insure the even piling of the sheet, whatever its size may be.

106. Fire Escape Ladder; Joseph H. Grimeley, New Lexington, Ohio.

Claim—The wheels turning on the axles at the ends of the wings or steps, for the purpose of providing a space between the ladder and wall for the feet and hands of the individual when descending, to enable and aid the ladder to reach the ground, said wheels being placed at the axle at the ends of the rungs, especially for this important purpose and object, viz: that with the wheels so placed it is of no consequence or difference which side of the ladder is uppermost when thrown out, making no difference which side of the same rests against the wall. Also, the straps, which, combined with a ladder of the necessary strength and weight, as small, enables a person of ordinary strength to rescue the aged, infirm, young, and those too timid to descend alone, by lowering them to the ground by the hand.

107. Shingle Machine; Erastus Hall and Joel F. Stewart, East Randolph, New York.

Claim—The rack pivoted to the carriage, in combination with the rod, plate, pinion, and lever, with weight attached, for the purpose of feeding the bolt to the saw and gigging back the same automatically. Also, setting the bolt of the saw, by means of the bar provided with the rack operated by the backward movement of the carriage through the medium of the wipers and boss or hub on shaft, provided with spiral ledges, and the spring catch.

108. Method of Coppering the Interior of Ships, to Protect them from Lightning; Roswell W. Haskins, Buffalo, New York.

Claim—Protecting vessels from lightning by means of metal linings, arranged as described.

109. Churns; James Hatfield, Falmouth, Indiana, and Henry M. Goldsmith, Burlington, Iowa.

Claim—1st, The manner and form of inserting the adjustable brake. 2d, The basin or reservoir lid, with glass slide attachment. 3d, The quarter circle wings or dashers at each end of the shaft, in the form and position described.

110. Tailors' Shears; Bachus Heinisch, Newark, New Jersey.

Claim—The oblique rectilinear slot in the elongated shank of the lower blade, in combination with the fulcrum and lever connecting the shanks.

111. Pump; George Hibsch, Buffalo, New York.

Claim—The two screw wheels in combination with the bands, when arranged in relation to the cylinder in the manner described.

112. Machine Pulleys; Caleb S. Hunt, Bridgewater, Massachusetts.

Claim—The construction and use of machine pulleys with the bearing or band surface made of cork, as described.

113. Shoemakers' Edge Planes; Freeman Killbrith, Pembroke, Massachusetts.

Claim—The attachment to the edge now in use, and known as Dunham's patent, of the movable guard with its screw, the guard being movable to and from the edge of knife, and sliding on the face of the shank; and also the attachment to the shank of the knife, with its screw working in a slot, and raised or lowered to any desired gauge for paring soles, and which knife can be wholly removed from the shank by unscrewing the screw, and so ground or sharpened, and be replaced by a new knife if necessary.

114. Adjustable Pile-driver; T. W. Loveless, Corning, New York.

Claim—The frames connected by pivots or joints, and retained in desired positions by the perforated segment plate and pin, in combination with the bolster and bars attached to the frame and secured in desired position by the racks, serrated plates, and bar or clamp.

115. Paper Stock from Reeds; Henry Lowe, Baltimore, Maryland.

Claim—The prepared reed fibre, or new article of manufacture above described, as a substitute for rags, ropes, and other fibrous materials, for the manufacture of paper, said reed fibre or paper stock being prepared as set forth.

116. Machines for Drilling and Splitting Stones; John H. Lyon, Baltimore, Maryland.

Claim—The hammer stock and hammers, in combination with the drills and removable slugs for drilling and splitting blocks of stone.

117. Carriage for Sawing Machines; A. C. Miller, Morgantown, Virginia.

Claim—Arranging the head blocks in long mortises in the side pieces, and connecting the outer ends of said head blocks by overlapping arms or levers, furnished with adjusting holes or an adjusting screw, so that any length of bolt within the capacity of the saw may be held and operated therein.

118. Reaping and Mowing Machines; C. Moul, Hanover, Pennsylvania.

Claim—The combination of the truck frame, caster wheel, and lever.

119. Escapement of Watches; Jacob Muma, Hanover, Pennsylvania.

Claim—The escapement, consisting of a single escape wheel and two geared balances, with cylinders or cylindrical segments engaging with the said escape wheel or opposite sides of its axis, when said escape wheel and balances, with their segments, are arranged in relation to each other, with their axes in the same plane, and the gear of the said single escape wheel, with the segments, serves the double purpose of escape and of giving impulse to the balances.

120. Boat Propeller; Mortimer Nelson, City of New York.

Claim—1st, The vertical buckets, when arranged so that they shall be capable of folding against the side of the propeller frame, whether turned on their axis to the right or left, in combination with a reversible stop, which will, after being adjusted, hold the buckets in a position for acting against the water during the time the engine piston is making a stroke to effect the propulsion of the boat, either backwards or forwards. 2d, The arrangement of the buckets on the inner side of one of the propeller frames, and on the outer side of the other, in combination with the supporting slides.

121. Hemp Brakes; George M. Newell, Lexington, Missouri.

Claim—1st, Giving the slats of the pivoted frame a curve which is concentric with the axis on which the

frame in which they hang reciprocates, and arranging said slots or swords so as to move in curved slots of stationary pillars as the frame reciprocates. 2d, The arrangement below the breaking swords or slats, of two sets of stationary beaters or whipping rods and two sets of reciprocating beaters or rods, the latter being attached to pivoted rocking arms provided with curved slats, so that they shall reciprocate in the path of a vertical circle, and operate in combination with the stationary rods.

122. APPARATUS FOR CLEANING AND POLISHING COFFEE; William Newell, Philadelphia, Pennsylvania.

Claim—In combination with the cylinder which contains and furnishes heat to the coffee, the open wire diaphragms or partitions for furnishing rubbing surface. Also, in combination with the open wire rubbing surfaces, the flanches and heating tubes.

123. ENDLESS CHAINS FOR THRESHING MACHINES; Job E. Owens, Clark Lane, and E. G. Dyer, Hamilton, Ohio.

Claim—A chain composed of two different kinds of malleable cast iron links, as represented, and when the alternate links of chains are the duplicates of each other throughout the series, and the two kinds of links united in the manner set forth.

124. MANUFACTURING KNIT GLOVES; James Peatfield, Ipswich, Massachusetts.

Claim—The manufacture of seamless knitted gloves by knitting the hand and the fingers and thumb separately, and uniting them in the manner described.

125. GOVERNOR FOR STEAM ENGINES; C. T. Porter, City of New York.

Claim—1st, In combination with arms and balls, or their equivalents, revolving at a much higher velocity than would be natural to them, considered as a conical pendulum, the employment of a counterpoise, applied as described, and so proportioned in weight as to balance, or nearly so, the centrifugal force developed by the revolution of said arms and balls, or their equivalents. 2d, So applying the counterpoise to the governor that its effective load shall be lessened as the governor rises, or as the balls and arms thereof, or their equivalents, expand, for the purpose of rendering it constant, or as nearly so as desired, relatively to the power of the governor to sustain it. 3d, The employment of the counterpoise applied to the governor in any manner substantially as specified, as a means of fixing or adjusting the exact speed of the engine.

126. REFRIGERATOR; Henry Rehahn, City of New York.

Claim—In combination with the ice-box and ventilator arranged near the top of the refrigerator box, the centrally located cold air tube for carrying the cold air from said ice-box down to, or near the bottom of, the refrigerator, and admitting it into the refrigerating chamber, and in between the inner and outer cases, thence it ascends and escapes through the register.

127. MEDICATED VAPOR APPARATUS; Alex. F. Rose, Brooklyn, New York.

Claim—1st, The construction of the mask with a marginal cushion, a single or double back as passages. 2d, The construction of masks for encircling the neck or other part with a band of wire cloth, or other sufficiently flexible but yet sufficiently stiff material, a marginal cushion, a passage box, and an enveloping cloth of water-proof.

128. GAS GENERATORS; G. W. R. Seal, Winchester, Virginia.

Claim—The employment of a secondary movable diaphragm applied within the retort, so as to support a portion of the cellular packing, and to be capable of being raised and lowered with such portion of the packing.

[NOTE.—A retort divided into two chambers is employed, in one of which the substance to be converted into gas is made into vapor, and in the other the vapor is converted into permanent gas, by passing through a packing of cellular character, so that it comes in contact with a great amount of heating surface. The invention consists in the employment of this cellular packing of shavings or scraps of copper or its alloys, by whose superior conducting powers the vapors are more rapidly heated and decomposed than when pebbles or scraps of iron are employed to form cellular packing in the retorts. An extra diaphragm is also employed in the second chamber to support a portion of the packing, and it is movable to vary the depth of the packing to suit the various materials that may be employed to make the gas.]

129. CHURN; N. H. Sherburne, Campton, Illinois.

Claim—The combination of heads, slides, blades, and opposite rotating shafts, constructed as set forth.

130. GRAIN CLEANING MACHINES; N. H. Sherburne, Campton, Illinois.

Claim—The concentric and opposite moving fans, in combination with the corrugated head of the upper screen.

131. SCROLL-SAWING MACHINE; E. Sirret, Jr., Buffalo, New York.

Claim—1st, The bent levers or bell cranks, H I, attached to the cross-heads of the saw, and operated by the eccentrics, or their equivalents. 2d, Having the upper lever or bell crank, I, attached to an adjustable plate operated by a screw, or its equivalent, for the purpose of readily and properly straining the saw and allowing the same to be relaxed and removed with facility from the machine.

132. ROLLING RAILWAY CHAIRS; J. H. Snyder, Troy, New York.

Claim—Forming or turning the tip or lips of the chairs upon the collar or collars of a roller, by means of another roller.

133. BUTTER COOLER; James H. Stimpson, Baltimore, Maryland.

Claim—A butter cooler made with an ice receptacle suspended over the dish, in the manner set forth.

134. ATTACHING SLEIGH RUNNERS; Wm. W. St. John, Lima, New York.

Claim—The combination of the T-formed slide, cap, and joint, for attaching the hind runner of sleighs to the body, when said runner is drawn by a connexion to its forward end.

135. COTTON GINS; Joshua Tetlow, Taunton, Massachusetts.

Claim—The rollers, one or more, grooved longitudinally and parallel with their shafts, and grooved also in a zigzag manner in connexion with the adjustable stationary plates and vibrating plates.

136. APPARATUS AS AIDS IN EXTRACTING TEETH; Charles C. Thomas, Natchez, Mississippi.

Claim—A dental instrument having the adjustments substantially as stated.

137. EARTHENWARE DISHES; Alson and Tracy Vail, Berlin, Wisconsin.

Claim—A covered dish with an absorbent lining perforated and unperforated, as specified.

[NOTE.—This invention consists in making dishes porous on their inner surface, so that the moisture shall be absorbed from hot eatables, and the same kept in a dry and palatable condition. To accomplish this result

the dish is formed of some porous argillaceous substance and only glazed on its exterior, or if the dish is of china-ware it may be rendered capable of absorbing moisture by being lined with a porous perforated substance.

138. Refrigerators; Nathaniel Waterman, Boston, Massachusetts.

Claim—The arrangement of the air supply and discharge pipes with respect to the case and its refrigerating chamber, in which arrangement the supply pipe or pipes are disposed within the refrigerating chamber, while the discharge pipe or pipes are disposed outside of the same. Also, the combination of a series of grooves or an auxiliary space or spaces, and a discharge pipe, or their equivalents, with the metallic bottom or lining of the refrigerating chamber, and arranged under the same and within the case or the stopping or bottom part of such case. Also, the arrangement of a space within the cover of the refrigerator, and around the odor discharge pipe.

139. Automatic Mechanism for Operating the Surveyor's Graphodometer; J. M. Wampler, Baltimore, Maryland.

Claim—The combination with a moving strip of paper, or other proper material, arranged on any suitable vehicle of automatic mechanism for taking and recording distances and courses or distances and levels, or distances, courses, and levels.

140. Smoke Stack for Steam Vessels; Wm. Webster, Jefferson Co., Washington Territory.

Claim—1st, The arrangement of two or more pipes, &c., within an outer shell, as described. 2d, The application to a double shell smoke stack of the registers, &c.

141. Saw-Mill Block; Hiram Wells, Florence, Massachusetts.

Claim—Operating the dog bar of the block by means of the lever fitted in the underside of said bar, the ribbed plate connected with the bar by the obliquely slotted plate and pin.

142. Tripod-Head for Surveyors; Wm. J. Young, Philadelphia, Pennsylvania.

Claim—Constructing the head of a surveyor's tripod in such a manner that the portion to which the instrument and plumb-line are attached may be adjustable in any direction horizontally to the portion to which the legs are jointed, when the usual leveling screws serve the purpose of binding the two portions of the head together after adjustment.

143. Leather Shaving Knife; J. B. Wentworth, Lynn, Massachusetts.

Claim—The leather shaving knife, consisting of a stock with a bevel only on one edge, extending beyond the centre from Y to Z, and provided with screws combined with a blade having slots.

144. Self-dumping Coal Bucket; John Wust, Philadelphia, Pennsylvania.

Claim—The employment of the handle attached by pivots below the centre of gravity of the bucket, in combination with the sliding rod and the spring bolt.

145. Floor Clamps; H. C. Wight, Worcester, Massachusetts.

Claim—The toggle formed of the levers connected with a screw which passes or works through a pivoted nut, in combination with the claw-plate and head or jaw, attached respectively to the levers, the whole being arranged and connected with the frame.

146. Boot Trees; A. J. Wisner, Homer, New York.

Claim—The combination of shaft, G, bevel wheels, screw, H, nut, I, screw, F, and yoke, with the thin shaft, E, and hinged sole.

147. Device for Securing Lightning Rods; Victor Schrage, Cincinnati, Ohio.

Claim—The spiral spring, as constructed and arranged to the insulator, in the manner described.

148. Radiators for Heating Buildings, &c., by Combustion of Gas or Alcohol; I. H., Assignor to Wm. A. Chester, Cincinnati, Ohio.

Claim—The radiator constructed with a central opening in its bottom to receive the flame and heated products of combustion from the burner, and with the surface of said bottom inclining downwards from said opening towards two openings at the ends, and with the wire gauze cylinders, or their equivalent, between the slides, by which means combined, provision is made for the condensation and free escape of the water of condensation, together with such carbonic acid as may be absorbed by it.

149. Manufacturing Chair Backs; S. F. Foster, Fitchburg, Massachusetts, Assignor to Walter Heywood Chair Company.

Claim—The rest, consisting of two jaws which are moved an equal amount on each side of a vertical plane passing through the centre of the cutters, as the thickness of the stuff varies.

150. Atmospheric Regulator for Stoves, Furnaces, &c.; B. Holly, Assignor to self and J. T. Edwards, Seneca Falls, New York.

Claim—The employment of a pendulum or balance having a movable axis connected with the valve or damper by the levers, or their equivalents, in such a manner that the gravitating force shall increase as the damper closes, and diminish as it opens, for the purpose of regulating the admission of air to the fuel. Also, the method of hanging the dampers by means of the convex pivot, bearing arm, and sliding pivot.

151. Spinning Frames; Amasa Houghton, Putnam, Connecticut, Assignor to self, E. D. and George Draper, Milford, Massachusetts.

Claim—The application of the cap to the upright spindle and the holster, so as to operate therewith.

152. Water-wheels; D. K. Kraatz, Ephrata, Assignor to self and I. S. Roland, Bareville, Pennsylvania.

Claim—The perforated flanch which closes the spaces between the upper ends of the series of buckets, when the perforations in the said flanch are made to open into a close air chamber.

153. Hand Stamps; Wm. Morse and John Hughes, Boston, Assignors to G. H. and A. F. Devereux, and O. W. and E. E. Barrett, Salem, Massachusetts.

Claim—Combining with the stamping mechanism, a cast off mechanism for discharging the letter or article to be stamped from the bed or the cast off over the same. Also, combining the pad or cushion with, or arranging it directly upon, the cast off or plate thereof. Also, the combination for operating the cast off, the same consisting of the arm, the tripper, the arm, the shaft, and the spring.

154. Machines for Cleaning Grain; Wm. H. Orr, Assignor to Wm. M. Griffiths, Martin's Ferry, Ohio.

Claim—The application of the auxiliary shaft, constructed in the manner set forth.

155. Cooling Car Wheels; Robert Poole, Assignor to self and G. H. Hunt, Baltimore, Maryland.

Claim—The process of regularly cooling car wheels, whereby all strain within the wheel is avoided, the chill uninjured, and the web of the wheel is without curve or corrugation.

156. Machinery for Polishing Thread; Britton Richardson, Assignor to self and the Hayden Manufacturing Co., Haydensville, Massachusetts.

Claim—The construction of the dressing and polishing rollers, with ribs covered with flannel, felt, or material of similar character, and arranged relatively to each other.

157. Furnaces for Manufacturing Zinc Oxide; Joseph Wharton, Philadelphia, and Nathan Bartlett, Bethlehem, Pennsylvania, Assignors to Joseph Wharton, aforesaid.

Claim—1st, The construction and arrangement of the furnaces of double the usual length, without any separating end wall, and with a charging door to each extremity. 2d, The construction and combined arrangement of the conduit, the damper or valves, and the chimneys, in the manner set forth. 3d, The series of tweers opening into the conduit.

JULY 20.

158. Tube Joints for Condensers; Horatio Allen, City of New York.

Claim—Making the joint formed by two metal surfaces (as in the joints of the tubes in the tube sheets of surface condensers, and other similar instruments,) tight, by inserting between the tube and tube sheet a tube of seasoned or compressed wood, made either in one or several pieces, relying on the expansion of the wood after being saturated by water to make the joint tight, and on the freedom of the metal tube to move endwise without affecting the tightness of the joint, to avoid injurious results from the expansion and contraction of the metal tube.

159. Connecting the Ends of Railroad Rails; K. H. Allen, Worcester, Massachusetts.

Claim—The combination of the rails, elliptical or spheroidal band, chair, and adjustable wedge.

160. Knife Cleaner; J. J. Banta, Jersey City, New Jersey.

Claim—The combinations of the cushions and hopper with the spring.

161. Combination of Electro and Permanent Magnets to render Telegraphing Magnets easy of Adjustment; Edmund F. Barnes, Brooklyn, New York.

Claim—The combination and use in a telegraphic line, or in connexion with telegraphic instruments, of the permanent magnet with the electro-magnet, to prevent the disturbing effect of atmospheric electricity, &c. Also, constructing the permanent magnet as an armature of the electro-magnet, with soft iron inserted therein, to render its action more forcible in connexion with the electro-magnet.

162. Twine Box; W. R. Bennett and C. Storer, Boston, Massachusetts.

Claim—In combination with the box, the eyelets attached to the shaft. Also, the knife guard.

163. Washing Machine; William Brown, Duncannon, Pennsylvania.

Claim—1st, The manner of hinging the forward portion of the rubber to the rear portion of the same. 2d, The manner of hinging the rubber to the uprights, in combination with the manner of suspending the uprights by means of slots, pivots, and springs.

164. Machine for Sharpening Gin Saws; A. H. Burdine, Chulahoma, Mississippi.

Claim—1st, The arrangement of the adjustable feeding pawl, spring file frames, and slotted or jointed adjustable frame. 2d, The particular arrangement of the self-clamping and self-sustaining frame, in combination with the pawl for the particular, purpose of feeding old circular gin saws while on the shaft and in the grain frame. 3d, The particular manner shown of arranging the clamping part of the frame on the upper part of the frame.

165. Ploughs; G. D. Colton, Galesburgh, Illinois.

Claim—Arranging the frame, B, secured to the axle with the strap, cord, and windlass. Also, this in arrangement with the revolving colters and a double-pointed beam.

166. Machines for Cutting Out the Soles of Boots and Shoes; John Crawshaw, Rochester, New York.

Claim—Combining the cutter and the pattern with each other and with the wheel, by means of the pattern gear, pinion, groove, tongue, cutter carriage, slot, and the cutter stock.

167. Fire Boxes for Locomotive Engines; Leonard Crossman and Samuel Atkinson, Elizabeth City, N. J.

Claim—The arranging of the grate bars centrally in the bottom of the fire box of wood-burning locomotives, and surrounding said grates with dead plates, when said grate bars and dead plates are susceptible of being removed or replaced.

168. Manufacture of Hard Rubber Goods; Gustavus Cuppers, College Point, New York.

Claim—The improvement in the hardening or curing process of caoutchouc or india rubber and of gutta percha, by which articles, wares, goods and merchandize may be manufactured into any desired size, form, or shape, as described.

169. Steam Heater; Chauncey A. Dickerman, New Haven, Connecticut.

Claim—The arrangement of the chest of steam heating flues, mutually parallel and inclined, in combination with similarly inclined and parallel air flues heated thereby—both the steam and the air having passed once through its flue on passage across the chest, is at once discharged to its final destination.

170. Spring Bolt; Edward Doen, New Britain, Connecticut.

Claim—The combination with the guided sliding bolt and surface plate, of a loose or freely arranged spring let into the body of the bolt, and protected or encased thereby for operation on, at points some distance apart, and with the bolt and against the surface plate.

171. Grinding Mills; Gerrett Erkson, City of New York.

Claim—Combining with the two eccentric grinding plates having the said axis of rotation, a male and female nut, concentric with each other, and attached to, and rotating with, the eccentric plates.

172. Making Watch Cases; Edwin Field, Providence, Rhode Island.

Claim—1st, The use of the rolls, s s, in connexion with the rolls, r r, constructed as specified. 2d, The

peculiarly shaped threads, E 1 E 2, of the mandrel, to prevent flattening, and for properly stretching the centre stock in coiling the same in the first instance, E', and for shaping and imparting a proper incline to the bevel stock in the second instance, E 2.

173. CARPENTER'S RULE; Wm O. C. Fritschler, Brooklyn, New York.

Claim—The arrangement and combination of the level with the movable arm furnished with a spirit level upon the centre, so that by means of the arc and the screw the glasses may be so placed as to indicate the precise position in relation to the "plumb and level," whatever may be the variation of angle the part b may necessarily assume, the said variation being indicated by the scale on the arc.

174. CANAL BOAT; James E. Gibson, Port Carbon, Pennsylvania.

Claim—In combination with canal boats made in two parts, so coupling the parts together that each shall have an up-and-down movement independently of one another.

175. SAW-FILING MACHINE; Heman How, Georgetown, Massachusetts.

Claim—The crank shaft operating in combination with the slotted, upright or moving frame, the flat spring, and the round metallic springs.

176. SEED DRILLS; J. W. Kirk, Rising Sun, Maryland.

Claim—A seed hopper which has at each point of discharge two passages arranged alongside, and one a little in advance of the other, and both used at the same time, in combination with a seed slide which has two passages similarly arranged, and of equal depth with each other.

177. MACHINE FOR PRESSING GRAPES; Henry Krause, City of New York

Claim—The soft roller, in combination with the adjustable hard roller, by means of the cogged gearing.

178. CASTING HINGES; Conrad M. Lane, Cincinnati, Ohio.

Claim—Casting the knuckles of the respective leaves, so that the inner parts or sides of the knuckles will form parts of cylinders of smaller diameter than the outer parts, to admit of the easy moving of the joint without additional labor or finishing.

179. MACHINES FOR DIGGING POTATOES; Malcolm Little, Clyde, New York.

Claim—The arrangement of the fork within and in combination with the roller.

180. MILL STONE DRESS; George W. Loy, Jefferson, Texas.

Claim—Having the two stones, A B, provided respectively with straight and curved furrows, disposed or arranged as shown.

181. CASTING IRON KETTLES; Cornelius McGinniss, Pittsburgh, Pennsylvania.

Claim—Constructing the metallic core of three or more pieces, united by bolts so as to be readily detachable, one of which pieces is a narrow central strip, which may be removed after the kettle is cast, and before it is sufficiently cool to remove the entire core, for the purpose of allowing the contraction of the casting without danger of bursting.

182. VAPOR BURNING LAMPS; Nicholas Mason, Chelsea, Massachusetts.

Claim—1st, The two holes, q q, in the wick tube, for the purposes set forth. 2d, My cylindrical sheath, arranged and operating in the manner described. 3d, I do not claim cutting off the gas by means of rolling valves, as this is common in steam engines, and in gas and water cocks, and other lamps:—but I claim the double row or series of rolling valves contained within the mouth-piece of the burner, arranged and operating in combination with each other, and with the throat-piece of the wick tube.

183. PROPELLER; Datus E. Merrick, Cleveland, Ohio.

Claim—The special form of the wing, having its angular position upon the shaft, in combination with the flanch having its greatest depth at the central part of the periphery of the wing, and tapering therefrom each way to the edge of the wing.

184. BREECH-LOADING FIRE ARM; James H. Merrill, Baltimore, Maryland.

Claim—Converting what is known as the "Jenks' carbine" from a loose powder and ball-loader to a cartridge loader, viz: by plugging up the vertical opening through which that gun was loaded, cutting away in rear of the barrel, so as to load at the rear end of the bore, and allowing the lever, toggle, and piston to come far enough back to admit a cartridge to be dropped in behind the bore, and then run up into the chamber, with a groove and pin to guide the toggle and piston.

185. MACHINE FOR MAKING CHAIN; Edwin H. Perry, Providence, Rhode Island.

Claim—1st, The perforated plate, or its equivalent, in combination with a former for striking up the body of the link, the two so combined performing the function of enabling the link after it is struck up in the die to be lifted out of the same for the purpose of being deposited in the next position necessary in the formation of the chain. 2d, The arrangement of the slides for bending over the arms of each link after it has been struck up in the die. 3d, Constructing the end of the tube wherein the chain is formed, so that it shall be enabled to perform the function of grasping the link when deposited in it, and retaining it at the same time, holding it firmly in place while the arms of the under link are being bent over it. 4th, In combination with said tube the adjustable contracting collar, for the purpose of regulating the degree of resistance which must be overcome in forming the chain, by means of which the chain can be, at pleasure, woven more or less compactly.

186. METHOD OF FEEDING THE TOOL CARRIAGE IN TURNING LATHES; Adam Rennio, Binghampton, New York.

Claim—The combination of the lever with the arms, and the jointed propeller with the racks, and respectively, for the purpose of feeding the tool carrier. Also, the back rest, L, for the purpose described.

187. MACHINE FOR MAKING AXE POLLS; George Reynolds, Manchester, New Hampshire.

I do not claim, broadly, the method described of manufacturing an axe poll, by compressing a bar of metal between dies or swages projecting from the face of the rolls in which they are set. Neither do I claim as new the use of a die provided with a groove or recess in which the head of the axe poll is to be formed.

Claim—1st, The use of a drawing die, D', provided with projections, so that the blank of metal when subjected to compression shall be thereby drawn out farthest at the corners, whereby the bit can be more completely welded into the poll, and the eye of the axe in consequence be made more perfectly. 2d, Making the lower die, D, with a recess or groove across its face of the form, so that the metal which forms the head of the axe poll shall be thereby crowded toward the edges of the head instead of being piled into a ridge in the middle, and at the same time a greater proportion of metal be forced into the back of the head. 3d, The combination

of the feeding fingers with one or more cams, so arranged that at the proper moment of time, the blank of metal can be by the machine automatically fed between the dies, to undergo the several operations to which it is to be subjected. 4th, In combination with the dies or rolls, an adjustable guide and gauge, either with or without the spring fingers. 5th, The compressing clamp for holding the axe poll and shaping the head of the axe during the operation of bending.

188. STRAW CUTTERS; Robert Sinclair, Jr., Baltimore, Maryland.

Claim—The arrangement of the teeth upon the masticating and propelling cylinder, constructed with the nodular projection on either side, and operating like molar teeth to propel and crush the fodder.

189. RAILROAD SWITCHES; G. R. Smith, Ithaca, New York.

Claim—The rack and pinion at the base of a perpendicular rotating or partially rotating shaft, when combined with a spring lever and a circle or a segment of a circle, said lever being fixed at right angles to said shaft, and playing on said circle or segment, and into slots in the same, and said segment or circle being horizontal. Further, the above named combination when further combined with a signal lantern, which lantern revolves wholly or in part, when adjusted to the top of said shaft, said lantern having different colored glasses, and revolving on an axis drawn perpendicularly through the centre of said lantern.

190. HEEL SHAVERS FOR BOOTS AND SHOES; Varanes Snell, North Bridgewater, Massachusetts.

Claim—Combining with the stock and the stationary knife the adjustable guard, so arranged as to be susceptible of being removed from the said stock.

191. FIREMEN'S TRUMPETS; Wm. Staehlen, Williamsburg, New York.

Claim—The end-piece and body, constructed in paraboloidal form, and arranged relatively with each other and the mouth-piece.

192. CLOTHES DRYER; S. H. Tift, Morrisville, Vermont.

Claim—The combination of a shaft, hubs, and arms, and braces, with the sliding collar and catch.

193. MACHINE FOR CUTTING BOTH BEVELS SIMULTANEOUSLY ON BARREL HEADS; A. D. Stewart, Bennington, Vt.

Claim—The arrangement and combination of saws, f g, saw, J, and mandrel, H, whereby both bevels are simultaneously cut.

194. STEAM STOVE; J. L. Sutton, Norristown, Pennsylvania.

Claim—A stove or furnace and boiler, with two or more concentric radiators around or above said boiler and furnace, and arranged to receive the air heated by said furnace and boiler, and impart additional heat to it as it ascends around and between them.

195. APPARATUS FOR HANGING UP AND CARRYING OFF PAPER HANGINGS; T. Van Deventer, New Brunswick, New Jersey.

Claim—1st, The employment of the intermediate bands, in combination with the hanging-up belts and carrying-off bands. 2d, The springs applied to the lath box.

196. MANUFACTURE OF STEATITE ARTICLES; J. Von Schwarz, Nuremberg, Bavaria.

Claim—Preparing gas burners, or other articles of manufacture, from the natural substance known as steatite, in such a manner as to give said articles an intense degree of hardness, and also a capacity to resist high temperatures.

197. APPARATUS FOR RECTIFYING; Gardner Waters and J. W. Harnett, Cincinnati, Ohio.

Claim—1st, The use of solid plates with bent pipes, or their equivalents, instead of perforated plates in the beer column. 2d, The use of the exhaust steam regulator, in distillation, by this or other apparatus, whereby steam of any degree of tension may be taken from the boiler, and reduced to any less desired uniform pressure; and whereby the exhaust steam from engines may be regulated in like manner, using the exhaust steam from boilers, together or separately as may be desired. 3d, The combination of the beer and spirit columns with the exhaust steam regulator, with or without the whistle valves, acting as described.

198. PLOUGHS; Walter Warren, Penn Yan, New York.

Claim—The arrangement of beam and its portion, with the mould-board and its land-side portions, for the purpose set forth.

199. LOOMS; Joseph Welch, Philadelphia, Pennsylvania.

As a multiplier of the pattern wheel of looms has been used before, and patented by Barton H. Jenks, on the 24th of October, 1854, I do not claim, broadly, increasing the capacity of said pattern wheel by means of a multiplier. But I

Claim—As an improvement in the said multiplying apparatus, the arrangement and combination consisting of the extra ratchet wheel and its pinion, in connexion either directly or indirectly with the pattern wheel; the adjustable pawls, c′ and c″, on their actuating lever, and the prolongation on the usual operating pawl, c, of the pattern wheel, the said devices being arranged so as to effect the changes as desired, in number at any given point of the pattern wheel during its rotation.

200. ELECTRO-MAGNETIC HOUSE ALARM; Wm. Whiting, Roxbury, Massachusetts.

Claim—The improved house alarm, consisting of a combination of the following elements, viz: 1st, a series of electro-magnetic circuits; 2d, an indicator to designate the respective circuits; 3d, an alarm apparatus; 4th, the window or door springs—the whole operating to sound the alarm, and indicate the circuit attacked.

201. MACHINES FOR HULLING AND CLEANING RICE; David Henwood and James Stephens, Assignors to selves and T. F. Rowland, Brooklyn, New York.

Claim—The cylinder provided with wedge-shaped spiral grooves, inclining outwards and downwards, in combination with the stationary india rubber lining, or such equivalent lining that is firm enough to hull the grain, and yielding enough not to break much of it in the process of hulling. Also, making the top of the cylinder convex or conical with curved or wedge-shaped grooves, in combination with the stationary adjustable disk above it, lined with india rubber, gutta-percha, or some equivalent substance. Also, a cylinder covered with wire card clothing, in combination with a cylinder of perforated sheet metal, when both are made to revolve in opposite directions. Also, the huller covered by the first claim, in combination with the scourer covered by the fourth claim.

202. FLOURING MILLS; Samson Wolff, Vicksburgh, Mississippi.

Claim—Increasing or decreasing the effective grinding action or friction of the stones, without the necessity of changing the distance between the grinding surfaces, by having the spindle of the running stone

arranged between an unyielding but adjustable step, and a pivoted weighted yielding lever, in the particular manner specified.

203. COTTON PRESSES; R. G. Williams, Hannahatchee, Georgia.

Claim—So arranging the press in relation to the screw that any required length of lever for operating the press may be obtained, the press resting on the upper main sill instead of resting on the ground sill.

204. CLOTHES RACK; George Young, Jr., Saratoga Springs, New York.

Claim—The arrangement of the folding timbers with the central timber, by which the said folding timbers, when extended, form supporting legs in combination with the lower arms, widened for the reception of the supporting pins.

205. SOLDERING IRON; H. J. Behrens, Assignor to Charles S. Pomeroy, City of New York.

Claim—The use of a hollow soldering iron containing solder, with or without a valve to regulate the flow thereof. Also, the combination of a hollow soldering iron containing solder, with an opening through which the solder may pass as required in the process of soldering, its delivery being automatic to its use.

206. STRAW SHAKERS; Leonard Ellig, Mill Creek, Assignor to Andrew Garrett, Myerstown, Pennsylvania.

Claim—1st, The movable bottom, in combination with the arms and spring. 2d, The movable cap, adjusted as described.

207. BURNERS AND WICK TUBES FOR VAPOR LAMPS; M. Safford, Assignor to self and G. P. Kinney, Boston, Massachusetts.

Claim—The combination of the auxiliary wick with a lifter or rod, or with the same and extinguisher, so as to enable such wick to be moved in its tube, in manner specified. Also, in combination with the vapor generator and its auxiliary wick tube, a closing cap or extinguisher and one or more conduits applied in the wick tube, in manner as specified. Also, a foraminous wick tube, or its equivalent, in its combination with a main wick and an auxiliary wick, applied to it and to operate with it.

208. HORSE POWERS; Wm. Rider, Assignor to self and J. B. Sweetland, Almont, Michigan.

I do not claim broadly, a worm wheel and screw, as that is a well known mechanical device.

Claim—The arrangement and combination of the right and left screws placed in the shaft, in connexion with the worm wheels which gear into the screw, and are rotated from the driving wheel by means of the gearing.

209. FLUID METER; E. D. Weatherbee, Assignor to self and Lorenzo Harding, Worcester, Massachusetts.

Claim—1st, The arrangement of the weighted tube, D, the vessels, H and A, when constructed as set forth. 2d, The combination of the siphons, J J, with the vessels, H H, and tubes, G, with valves, I I.

210. CONVERTING ROTARY INTO RECIPROCATING MOTION; John J. Weeks, Assignor to Susan Weeks, Locust Valley, New York.

Claim—Forming the oblique arm on the rotating shaft, and placing the collar or hub with rod attached on said arm, the lower end of the rod being fitted in the slide.

JULY 27.

211. STONE-SAWING MACHINES; Horace L. Arnold, Elk Horn, Wisconsin.

Claim—The particular means employed for operating the screws, to wit: the rack and pinion gearing, rack shaft, H, rack, n', and the wheel, o', pawl, I, and pinion, p', placed on the shaft, F. Also, in combination with the above, the racks, m' g', attached respectively to the collar, l', and shaft, G, and used in connexion with the pinion, h'', and pattern, K. Also, the plates, j, provided with inclined planes, q, and having rods, k, and slotted bars, t, attached, which bars are connected with adjustable arm, c', whereby the saws are tilted or slightly raised at the termination of each stroke of the frame, and the saws also inclined, as occasion may require.

212. SELF-ADJUSTING AND EMBOSSING TELEGRAPHIC MACHINE; Edmund F. Barnes, Brooklyn, New York.

Claim—The use and application of the combined permanent and electro-magnets in the resident magnet. Also, the arrangement of the springs, or their equivalent, in connexion with the circuit breaker shaft and type wheel shaft, by which the circuit breaker arm and type wheel are caused to return to a given starting point after the completion of each letter, thereby causing the instrument to be kept constantly self-regulated. Also, the use and arrangement or combination of the circuit breaker wheel, D, with its undulated periphery, and the hammer and anvil, placed and arranged so that the revolution of the wheel, D, shall alternately connect and disconnect such hammer and anvil, and also connected with the main battery and line, for the purpose of closing and breaking the main telegraphic circuit. Also, the arrangement of the hollow shaft, and clutch, and arm, and the connexion therewith of the swing frame, by which the clutch wheel is made to take hold of such clutch on the hollow shaft to carry forward such shaft, and the circuit breaker and the arm, whenever any key is depressed. Also, the arrangement and combination of the vibrating lever and its nipple, with the escapement wheel constructed to cause the type wheel shaft to revolve step by step at every vibration of such lever. Also, the use and arrangement of the spring, L, with its adjusting slide and adjusting screws, for the purpose of regulating the action of the vibrating lever. Also, the arrangement and combination of the imprinting cam, the paper propelling eccentric, and the type wheel releasing plane, being attached to each other and placed upon a common shaft, or otherwise, but so that it is impossible that they should get into different relative positions. Also, in connexion with such imprinting cam, and paper propelling eccentric, and type wheel releasing plane, the arrangement and combination of the rod, z, bar, y, and imprinting press, x, and the rod, c', and the rod, o, which together cause the letter to be imprinted, the paper to be propelled far enough for the next letter, and the detent cog-wheel to be forced down, so that the type wheel may return to its starting point, and again forced up to touch the type wheel, and also cause each of these several things to be done at and in its proper time. Also, the arrangement of the armature, constructed of alternate plates of conducting and non-conducting metals, when combined with an electro-magnet, and used in connexion with telegraphic instruments, for the purpose of securing a more rapid vibration of such armature. Also, the arrangement of the coiled spring about the type wheel shaft, such spring being set up to and held at a given tension, and such tension being increased only a certain amount by the friction, for the purpose of securing prompt action to such shaft. Also, generally the arrangement and combination of the said several parts described.

213. PLOUGHS; Samuel R. Bliven, McDonough, New York.

Claim—The reversible share attached to the shaft and connected with the lever, in combination with the two mould-boards, the parts being arranged relatively with each other.

214. Omnibus Register; Louis Brauer, Washington City, D. C.

Claim—The employment of an elastic step, by means of the movable rods for operating the register plate and bell.

215. Coupling for Railroad Cars; George S. Bishop, Washington City, D. C.

Claim—1st, The squared chambered bumper block, when made to receive the sliding and block, to overcome the friction on pin and link. 2d, The lever, in combination with the pin, and block, and bumper head, and pin or handle. 3d, The peculiar manner of constructing the mouth of the bumper and its connexion with the V-shaped mouth of the block for holding the link to any desired horizontal angle, and by which the block may be tipped to prevent the link from being crippled, and also for holding the same in poise at any desired angle, the whole operated by lifting the pin.

216. Water-proof Cement; Abraham Brower, City of New York.

Claim—The composition composed of all the ingredients described, and in about the proportions for the purpose set forth.

[Note.—This composition consists of tallow, beeswax, resin, shellac, and glue.]

217. Bearing Blocks of Truss Bridges; Albert D. Briggs, Springfield, Massachusetts.

Claim—The method of increasing the bearing surfaces for the bearing blocks, by the employment of the combination of blocks or keys, and blocks, h h, the former being tightly fitted between the chord sticks and the said bearing blocks, and the latter between the ends of said bearing blocks outside of the chord sticks.

218. Method of Counterpoising Gasometers; P. T. Burtis, Chicago, Illinois.

Claim—The arrangement of the chains, e e, in combination with the weights, d d, and chains, a a, whereby when there is any tendency on the part of the holder, or the section thereof, to which said weights are applied, to work unevenly, the highest side is relieved from the counterbalance weights, and two of the said weights are brought wholly into action on the lowest side.

219. Plates for Burglar-Proof Safes; Ira L. Cady, Assignor to J. B. and W. W. Cornell & Co., City of New York.

Claim—Forming a burglar-proof combination plate by the union of a stratum of molten iron with one or two perforated face plates of wrought iron.

220. Sewing Machines; Luman Carpenter, Oswego, New York.

Claim—The combination of a tilting dog or cam, F, with its friction spring, H, and pivoted vibrating bar, G, when operated by the needle bar for feeding the cloth, in the manner described.

221. Axle Boxes, &c.; David Cumming, Sorrel Horse, Pennsylvania.

Claim—1st, The peculiar form of the outer end of the axle and tapering hole in box, F, when the said axle and box are arranged relatively to each other. 2d, The combination of the two inner portions of the box with the clasp.

222. Method of Cutting Boot Fronts; John Dick, City of New York.

Claim—Cutting a boot front out of a single piece of leather, or other material, to the form described, or to any other form, whereby it can be used (in making the same into a boot) without undergoing the operation of crimping.

223. Paints; J. S. D'Orsey, City of New York.

Claim—The paint composed of carbonate of lead or oxide of zinc ground in oil, mixed with carbonate of lime, and reduced by the compound vehicle specified, either with or without the addition of pulverized sand or sulphate of baryta and sulphate of copper.

224. Sewing Machines; Cornelius Donovan, Abington, Massachusetts.

Claim—The application or attachment to the sewing machine of the stop motion described, consisting of the lever, the cogged segment, the rack, the belt guide, the brakes, the crank, the springs, and the lever, h, the cam, the pulleys, and the belt running on them, the pulley, e3, arranged as described.

225. Sawing Machine; Wm. H. Doane and Carlile Mason, Chicago, Illinois.

Claim—The arrangement of the gearing in connexion with the levers and feed rollers, so that the rollers may be expanded and contracted without at all interfering with their rotation. Further, placing the rollers on the shafts, having the rollers hollow, provided with bearings which are fitted on the upper ends of the shafts, and also provided with pendent pins which are fitted over the drivers of the shafts, the upper journals of the rollers being fitted in adjustable bearings.

226. Operating Window Blinds; Andrew Ferber, Elizabeth City, New Jersey.

Claim—The rod fitted in one of the stiles of the blind, and provided with pins which are fitted in oblique slots, e, in plates, D, attached to the ends of the slats. Also, the rod attached to the slats, in combination with the spring fitted within the mortise and attached to the stile.

227. Harness Tug Buckle; John H. Feraw, Hinsdale, New York.

Claim—The double tongue, cog-wheel, and traversing bars, arranged and operating in the body or box, in a manner so as to adjust itself in lengthening out and taking up the traces.

228. Railroad Car Springs; John J. Fields, Brooklyn, New York.

Claim—The cup or receptacle formed with the larger cavity, the swell or ledge, the sloping or conical cavity, the elastic hollow cone or sheath, the inverted cone plunger or core part, through all of which the whole elastic principle or property of the material or substance used is brought into requisition, and the pressure or weight applied is equalized or diffused throughout the substance employed.

229. Stock for Holding the Cutters in Rotary Planing Machines; Ivers Gibbs, Worcester, Mass.

Claim—A planer arm of the external form, and having both longitudinal and vertical openings through it, for the purpose set forth.

230. Apparatus for Distributing Steam; Robert Hale, Roxbury, New York.

I do not limit myself to the exact form of "distributor" described, as it may be varied without departing from the spirit of my invention. For instance, if the distributor is placed in a corner of the tank, a quadrant shape may be found to be better suited to the position occupied by it, a flat cap may be placed over the funnel-shaped orifice of the connecting pipe, leaving an annular opening around it. Thus far I have spoken of my invention as particularly applicable to heating the feed water of engines, and it is my intention to employ my distributor in connexion with a method of separating a portion of the exhaust steam of locomotives, for the

purpose of heating the feed water, but it is obvious that it may be used to advantage whenever water is to be heated by the injection of steam as in bathing establishments and manufactories. I do not therefore limit myself to its employment for the purpose of heating the feed water of steam engines alone, but intend to employ it wherever it may serve to accomplish the end which I have in view.

Claim—The distributor described, or its substantial equivalent, operating as set forth, for the purpose of injecting the steam into the water in a thin sheet.

231. VALVES IN GAS APPARATUS; August Hendricks, City of New York.

Claim—In the application of water valves to the main pipe of gas retorts, the use of a loose perforated cover.

232. WHEELWRIGHTS' MACHINE; Wm. Hinds, Otsego, New York.

Claim—1st, Combining regular perpendicular ways, both in the mandrel carriage and the head blocks, to operate conjointly in adjusting the augers to different positions for boring. 2d, The method of adjusting the hubs for boring by suspending and revolving them on gudgeons in a carriage that vibrates the other way on a pin, and is set and controlled by thumb-screws, the revolving motion of the hub being set and controlled by index wheels and the latch. 3d, The entire construction of the spoke-holder and carriage, embodied therewith, together with the catch or hook for controlling its motion. 4th, The wheel carriage and plates to be used on the ends of the hub to confine the motion of the wheel to the axis of the hub and axle.

233. APPARATUS FOR REGULATING THE SUPPLY OF WATER TO STEAM BOILERS; Z. L. Jacobs, Hebron, Conn.

Claim—1st, The combination of a chamber having alternate communication, with a reservoir to receive a fluid, and a boiler or other vessel in which to deliver it, causing the fluid, when it rises to the desired height in the latter vessel, to check the passage of air and other aeriform bodies to the aforesaid chamber, and thereby to regulate automatically the flow of fluid from said chamber. 2d, The movable pipe, or its equivalent, in combination with the vessel, for the purpose of changing the line at which the fluid is to be sustained in the boiler or vessel. 3d, The ring and the plug, when constructed in the manner described.

234. "FLUSHING VALVE" TRAP FOR SINKS, SEWERS, &c.; Samuel Matthews, City of New York.

Claim—The combination of the basin and valve with the overflow culvert in the trap.

235. MACHINERY FOR PILING PAPER; J. C. Kneeland, Northampton, Massachusetts.

Claim—A combination composed of the following elements:—1st, a carrier made of endless bolts and rollers, or their equivalents; 2d, holders or holding mechanism, consisting of a rod or roller, one or more flexible strips or bars, or equivalent devices; 3d, mechanism to keep each roller of the carrier from revolving, while such roller is drawing the paper along over the table; 4th, mechanism to cause the roller to revolve and discharge the sheet of paper at the proper time; 5th, a table, or its equivalent, to receive the paper from the carrier. And in combination with the above described laying mechanism or combination of mechanical elements, I claim one or more bars or guards, arranged so as to prevent the sheet of paper while being carried forward from being drawn against the rear edge of the pack on the table, and being torn or injured thereby.

236. MANUFACTURING NAILS; John D. Krauser, Reading, Pennsylvania.

Claim—The process of making cut nails with improved points, that is to say, beveling both edges of the nail plate, so that the blanks shall be wedge-shaped at both ends, and forming the head by the action of the heading tool against the widest end of the blank.

237. SIGNAL LANTERN SWITCHES; S. N. Lennon, Deposit, New York.

Claim—Attaching the colored glass plates or slides, two or more of which are placed at each side of the lantern to a pendulous frame, placed within the lantern, and arranged in such relation with the colored plates or slides as to operate in connexion with the switch lever.

238. COMPOUND RAILS FOR RAILROADS; E. E. Lewis, W. B. Dunning, and C. Wheat, Genoa, New York.

Claim—The cap and base rail, constructed as described, and keyed together as specified.

239. PAPER MAKING MACHINES; Thomas Lindsey, Westville, and Wm. Geddes, Seymour, Connecticut.

Claim—The expanding lip or basin, in combination with the adjustable deckles and straps.

240. BRAN DUSTERS; S. B. Manning, Allegheny, Pennsylvania.

Claim—The use of a separate chamber covered with coarse wire net work, in addition to, and in combination with, the ordinary chamber covered with fine gauze wire net work.

241. CHURN; M. R. Marcell, Dansville, New York.

Claim—1st, In combination with the blower, the dasher, whereby a current of air blown through the dasher shaft is caused to issue from the dasher below the surface of the fluid in the churn in fine jets. 2d, The double deflecting plates, in combination with a churn box.

242. HANGING CARRIAGES FOR CHILDREN; Gilbert Maynard, Greenfield, Massachusetts.

Claim—Forming the springs of the chaise, and the axle bearings of the wheels of the same, by means of a single rod bent and applied to the device, as described.

243. GRATES FOR STEAM BOILERS; James Montgomery, Brooklyn, New York.

Claim—Combining with a boiler formed with a series of vertical water tubes, and the flue space among the said tubes communicating with the fire chamber at one end only, a grate made the whole, or nearly the whole length of the boiler, and with the fire door at each end.

244. SPLICE PIECES FOR RAILROAD RAILS; Ellwood Morris, Philadelphia, Pennsylvania.

Claim—Splicing together the ends of the two rails by means of a plate or plates so bent and formed, and so secured to the opposite sides of the two rails as to embrace the lower flanches of the same, and have longitudinal bearings against the sides, and at points above and below the narrowest portion of the rails, leaving a longitudinal open space between these points, transversely through which space pass the bolts for securing the splice.

245. SEWING MACHINES; Charles Moore, Buffalo, New York.

Claim—The elastic compression plate constructed with an offset or face which projects through the bed plate, and performs the combined functions of supporting the cloth equally upon all sides against the puncture of the needle, and of producing an equal pressure upon the cloth upon both sides of the seam or line of stitch when in the act of feeding. Also, the self-expanding looping springs, in combination with the slotted hanger and springs.

246. CLOSET FOR MILK; Edward H. Nash, Westport, Connecticut.

Claim—The box or case, in combination with the rotating shaft and shelves, arranged as specified.

247. STEAM BOILERS; Orrin Newton, Pittsburgh, Pennsylvania.

Claim—The mode described, or its equivalent, producing a more perfect calorification and expansion of the steam after it leaves the prime steam generator, and before it enters the cylinders of the steam engine, by means of two or more steam chambers, constructed as described, separate from the boiler, and heated by hot air from the furnace; the steam thus anhydrated passing to the cylinder of the engine from one of these separate chambers, while the steam in the other chamber is being prepared for the next stroke of the engine.

248. WHEAT DRILLS; Edward O. Bryden, Lafayette, Indiana.

Claim—The combination and arrangement of the cutters and teeth, with the concentric halder holders and levers, E E, and the combination and arrangement of the slides and the levers, P P, with the pitmans and cranks.

249. ADJUSTING MOSQUITO BARS; F. C. Payne, Hebron, Connecticut.

Claim—The application of the slotted projection, the hanging weighted arm, in the manner described.

250. COMBINATION OF THE NEEDLE AND SUN-DIAL TO ASCERTAIN TIME; Charles R. M. Pohle, Richmond, Va.

Claim—Combining the magnetic needle with the sun-dial, so that the point of compass is at all times at hand, and thereby the time of day ascertained from the dial, by holding the dial horizontal, and due north and south.

251. GRATES FOR LOCOMOTIVE ENGINES; Joseph W. Pole, Philadelphia, Pennsylvania.

Claim—The construction of the tubular bars, with hollow upward projections fitted with movable top pieces, as and for the purpose specified.

252. GAS REGULATORS; J. H. Powers, Newark, New Jersey.

Claim—The arrangement of the annular pressure cup and regulating valve, in the double annular quicksilver basin, whose inner and outer channels are arranged at a distance apart to form between them a passage, through which a communication is established between the interior of the cup and the atmosphere.

253. COMPOUNDS FOR TREATING POTATO ROT; Lyman Reed, Baltimore, Maryland.

Claim—The treatment of the potato preparatory to planting to the process set forth, subjecting it to solar or artificial heat, and then to the action of the liquid described, or any other analogous or equivalent thereto.

254. MODE OF OPERATING THE MECHANISM OF PRINTING TELEGRAPHIC MACHINES; Thomas and Joseph Reeve, and Sidney M. Tyler, Brooklyn, New York.

Claim—1st, Arranging the keys in a flat plate or key-board, in a semi-circular form, securing thereby a direct connexion between such keys and the swing frame. 2d, Applying the points or clutches at a distance from the shaft, and in connexion therewith making such a shaft a round instead of a square. 3d, The use and application of an independent friction upon the type wheel shaft, to secure in connexion with the coiled spring more prompt and instantaneous action to such shaft and the type wheel thereon, whenever the magnet releases the escapement wheel. 4th, Disconnecting the receiving portions of the instruments from the transmitting portions, to assist the operator in transmitting.

255. BRICK MACHINES; S. C. Salisbury, Milwaukie, Wisconsin.

Claim—The large cylinder, in combination with a series of small cylinders, spring guard plates, and die box. Also, cutting the bricks of the required lengths from the continuously moving body of clay, by means of the double knife passing through the forming die.

256. COUPLING FOR HORSE RAILROAD CARS; Blaney E. Sampson, Boston, Massachusetts.

Claim—The method of constructing and applying the pole so that it shall be in position to shackle when brought against the platform at any common angle of presentation. Also, so applying the pole that it shall be supported by the car, instead of upon the horses, as is usually done.

257. THE PRODUCTION OF ILLUMINATING GAS; J. Milton Sanders, Cincinnati, Ohio.

Claim—Carrying the mixed vapors of water and hydro-carbon, formed in the manner described, into a retort, containing carbon at a high red heat, for the purpose of producing an illuminating gas.

258. CLOTHES WRINGER; Isaac A. Sergeant, Springfield, Ohio.

Claim—1st, The yoke provided with a suitable hitching arm, the said yoke being adapted to be temporarily attached to a wash tub, or readily disconnected therefrom, and employed as a bearing for a rotary clamp for wringing clothes. 2d, In connexion with the yoke, the movable clamp, and pawl, and dog, by means of which the said clamp is retained within the yoke, or may be readily removed therefrom at will to be cleansed or dried. 3d, In connexion with a rotary clamp for wringing clothes, the hinged and yielding hitching arm.

259. MACHINE FOR WEIGHING AND REGISTERING GRAIN; J. Scheitlan, Columbia, South Carolina.

Claim—1st, A bucket with two compartments for a grain weighing and registering machine, which is suspended freely from the arm of the balance until the weighing is completed, and does not require to be turned or oscillated to dislodge the grain. 2d, The combination of a bucket with a tipping bottom to open and close the compartments alternately with a tipping tray. 3d, The combination of the roller arm, or its equivalent, with the scale beam and registering apparatus, in such manner that the same part of the mechanism which makes the count, also re-sets and locks the tipping bottom, so that no miscount can be made.

260. FEEDING QUARTZ, &c., TO MACHINES FOR CRUSHING AND GRINDING THE SAME; Charles Powell Stanford, Mount Gregory, California.

Claim—The arrangement of a lever which is adjustable by a set screw in connexion with a shoe, in such a manner that said shoe is agitated by the dropping of the stamper, and some of the quartz, or other substance, is caused to fall into the pan or mortar at such a time and in such a quantity as desired.

261. CORN HARVESTERS; Albert Stoddard, Tecumseh, Michigan.

Claim—The combination with the main frame of the pinion, E, shaft, G, pinion, H, cog-wheel, I, saw, J, shaft, K, reel, L, guard, P, wheel, X, belt, W, shafts, V V, their pulleys, U U U U U U, endless belts, T T T, hopper, Z, its pivot and slide, 4, bar, 3, and caps, 5, when these several parts are arranged as set forth.

262. HORSE POWER MACHINES; James A. Stone, Rochester, New York.

Claim—The construction of the base when combined with the wheel, I, to form a trussed arch, whereby not only is great strength secured, but the length of the shaft and its consequent liability to vibration is lessened.

263. COMPOUNDS FOR PROTECTING TREES FROM INSECTS; Wm. W. Taylor, Dartmouth, Massachusetts.

Claim—The application of the bitter water left in the manufacture of sea salt, or its equivalent, to destroy canker worms, and other insects, in their attempts to ascend trees, as set forth.

264. SEED PLANTERS; J. H. Thomas and P. P. Must, Springfield, Ohio.

Claim—1st, The use of flaring inclined gutter-shaped arms on the shaft, which is arranged in the hopper, G, and lifts and agitates the grain, in combination with the peculiar construction of distributing slide described. 2d, The employment of the above wheat hopper, G, and its attachments, in combination with a grass seed hopper, H, and the flaring seed conductors, when said grass seed hopper and flaring conductors or spreaders are arranged behind the wheat hopper, and so located that the back board of the wheat hopper shall completely overhang the same.

265. CLOTHES DRYER; Stephen H. Tift, Morrisville, Vermont.

Claim—The arrangement of the light yielding bars, cords, or ropes, standard and light yielding legs.

266. MACHINES FOR CLEANING GRAIN; B. T. Trimmer, Rochester, New York.

Claim—Giving the screens an unequal, reversible, gyratory motion, for the purpose of neutralizing the centrifugal force of the grain, and retaining it in the centre thereof, in combination with the vertical vibratory motion, by means of the double reverse-acting cranks, cams, and springs, or their equivalents, arranged in the manner set forth. Also, the combination and arrangement of the blast generator, triple blast tubes, and their valves and removable diaphragm, with the screen box and return spouts, operating conjointly for separating, screening, and returning the grain, and for increasing, diminishing, and modifying the blasts for the various purposes required Further, the adjustable deflector, in combination with the screen box for returning the lighter grain through the screen, and re-subjecting it to the blasts, or discharging it as refuse.

267. TRIANGULAR BRACE FOR LOCKING THE PANELS OF FIELD FENCES; Charles Van De Mark, Oak's Corners, New York

Claim—As an improvement on the patent of June 2d, 1857, the brace, constructed as specified, when combined with panels formed as set forth, with the end locking pieces, and set together in a straight, or nearly straight line.

268. BUTTER MACHINE; Ellyson Yerby, Washington City, D. C.

Claim—The slide, as a disconnecting apparatus, when said slide is used in combination with the conical pan and agitator.

269. RAILROAD CAR BRAKES; Wilbur B. Wait, Portsmouth, New Hampshire.

Claim—The combination and arrangement of the frame together with the connecting joints with latch attached, the shaft, I, with drum attached, connecting with the shaft, A, by an eye, the belt passing round the axle, E, the lever, K, the levers or arms, C, with brake chains and rods attached, the guide bar and slot, the main shafts with cog-wheels attached thereto, and the slots and eyes or links, as described.

270. MAKING STEEL ROLLERS; Henry Waterman, Brooklyn, New York.

Claim—My improved compound rollers, consisting of the steel shaft, the iron cylinder, and the steel cylinder, forming the surface when fitted together and hardened in the manner specified.

271. ALARM GAUGE FOR STEAM BOILERS; Joseph Whitmore, Lowell, Massachusetts.

Claim—The combination of the steam whistle, W, valve, E, rod, L, spring, K K′, and its connexions, and box, D, when used in connexion with a steam boiler.

272. DRAWING INSTRUMENT; Wm. W. Wythes, Philadelphia, Pennsylvania.

Claim—1st, Causing the adjustable pencil-holder to revolve as the beam is turned on the adjustable centre, m, by means of the disk and endless chain, with the wheels and pulleys (or their equivalents), acting in conjunction with the same. 2d, The adjustable sliding piece, with its spindle and adjustable pencil-holder, when arranged as set forth. 3d, The spindle, d, with its adjustable bar, N, and pulley, f, and the spindle, e, with its adjustable bar, N, and pulley, h, in combination with the adjustable point and endless chain, the whole being arranged on the beam.

273. PUMPS; Henry Zeng, Elizabethport, New Jersey.

Claim—The combination of a loose plate or disk valve with the piston rod in the upper part of the cylinder.

274. MANGLES; D. Cumming, Jr., Assignor to D. Cumming, Sen , Mobile, Alabama.

Claim—The employment or use of the cylinder, B, having its axis fitted in fixed bearings, the cylinder C, having an elliptical surface on a portion of its periphery, and having its axis fitted in sliding bearings, and the wedges, D D, having weights attached.

275. KNITTING MACHINES; Joseph P. Delahunty, Cohoes, Assignor to self and Edgar S. Ellis, Assignor to Clark Tompkins, Troy, New York.

Claim—So arranging or adjusting the presser and connecting it with the yarn running to the needles, that, when the yarn breaks or fails, the presser will move and cease depressing the barbs of the needles, and thereby preventing the casting off of the "quarter" or web.

276. STOVES FOR BURNING SOFT COAL; Merriman P. Dorsch, City of New York, Assignor to Peter Dorsch, Schenectady, New York.

Claim—The combination of the perforated cone and rosette when arranged with regard to the fire box, and operating as set forth.

277. STEAM HEATING APPARATUS; Thomas Gordon, Assignor to Charles H. Bullard, Trenton, New Jersey.

Claim—1st, The application of water joints to the safety valve and steam pipes. 2d, The construction of the throttle valve with an inverted cup in a water-joint or case. 3d, Connecting the dome with a steam pipe by a water supply pipe. 4th, Arranging at the bottom of the radiator a caloric valve, as described.

278. GAS REGULATORS; Charles F. Holzer, Assignor to William B. Smith and Wm. Bromwell, Philadelphia, Pennsylvania.

Claim—The peculiar arrangement of inlet and outlet chambers, the valve, the inverted cup, the spring and guide pin, whereby the spring and the guide are effectually protected from contact with the gas, and provision is made for the return of all liquid matter through the inlet pipe.

279. SEWING MACHINES; Albert H. Hook, Assignor to Union Sewing Machine Co., City of New York.

Claim—A narrow space between the looper finger, e, and arm, in combination with the rough surface on g.

280. Illuminating Glasses for Vault Covers; Thaddeus Hyatt, Assignor to George R. Jackson & Co., City of New York.

Claim—Combining glasses of an inverted pyramidal, polygonal, or conical form, with the sash or metallic portion of an illuminating vault cover, or its equivalent, for the purpose of producing a wide spread and perfect diffusion of the rays of light which may pass through said cover into the apartment beneath.

281. Machines for Pegging Shoes; Leander Lackey, Sutton, Assignor to self and Elmer Townsend, Boston, Massachusetts.

Claim—The combination of the heavy inertia block with the weighted lever, and either the last or the standard for supporting the last. Also, the arrangement of the inertia block with reference to the lower bearings of the universal joint—that is, so that a vertical line passing through the centre of gravity of the inertia block shall fall on one side of, and at a distance from, the axis of such bearings. Also, combining with the inertia block and its universal joint a mechanism for revolving the inertia block twice while a sole on the shoe last is being pegged, consisting of the flanch, the griper, the connexion bar, the lever, the pitman, and the cam. Also, so arranging and applying the last standard on the inertia block, that the position of the standard may be varied on the block in order to change the inclination or slant of the pegs. Also, arranging and combining with the peg feeding mechanism, a mechanism for receiving each peg and condensing or compressing it just prior to its being driven into the sole, consisting of the slider, the hook, slide bar, the toggles, the pitman, and the mechanism for actuating the said pitman. Also, the combination of the wedged pitman, its side cam, the recessed post, and the stud of the feeder, the same being the mechanism for feeding the shoe along. Also, combining with the feeding mechanism a mechanism for imparting to the shoe last an intermittent, reciprocating, lateral motion, such as will cause the machine, when in motion, to insert two rows of pegs in the sole, consisting of the pitman, the notch, the recess, the stud, the heart cam, and the plate.

282. Railroad Car Seats; John McMurtry, Assignor to James B. Clow and John Best, Fayette County, Kentucky.

Claim—The combination and arrangement of the seat back, foot-board, and quadrants, for the purpose of making the seat adjustable and reversible at pleasure.

283. Burners for Vapor Lamps; G. W. Randall, Assignor to Reuben J. Todd, Boston, Massachusetts.

Claim—The application of the valve and its seat to the generator and the button or heat absorber, the same consisting in making such valve and seat tapering, and arranging them in the generator, and maintaining them in contact by the action of a spring, and connecting the valve with a separate button in such manner that the button, besides performing its office of absorbing heat from the flame, may serve with the spring to maintain the valve in place against its seat and to rotate the valve.

284. Revolving Fire Arms; Edward A. Raymond and Charles Robitaille, Assignors to selves, Jno. B. Richards, and Thomas K. Austin, Brooklyn, New York.

Claim—1st, The manner of controlling the motions of the lever, h, and spring, i, by means of the spring, m, roller, q, and incline, 10. 2d, Locking the chambers, d, by the end of the lever, h, taking the triangular recesses in the rear of the chambers, as said lever completes its upward movement.

Extension.

1. Type-Casting Machines; David Bruce, Jr., Brooklyn, New York; patented November 6, 1843; extended July 6, 1858.

Claim—1st, The male plate, n, constructed with a nipple protruding beyond its back surface and springs attached to the plate. 2d, The method of opening and closing the mould and tilting the matrix, by the combination and arrangement of the compound vibrating arm, H, and lever, J, arm, M and N, and spring, V, said lever, J, having a simultaneous vibrating movement on an axis on the vibrating arm, H, in the manner set forth. 3d, The adjustable mould block, o, combined with the vibrating arm, H. 4th, The combination of the adjustable frame, h, with the lower adjustable mould block, o, in the manner set forth. 5th, The combination of the circular collar, perforated with a rectangular opening in the centre, to admit the rectangular shaft or stem of the upper mould block with the hinge piece and adjustable frame. 6th, The manner of supplying the melted metal to the mould by a horizontally and vertically perforated piston placed below the level of the bottom of the metal pot, by which the metal is forced into the mould at a lower temperature than heretofore effected, and the metal remaining in the mouth of the female plate, after the type has been cast, is drawn back into the seat or chamber of the piston as the piston rises, by which the mouth of the female plate is prevented from being stopped or choked by congealed metal. 7th, The combined arrangement of these several parts, namely, the lever, a, cam, v, spring, d, rod, b, and vibrating beam, E, by which the piston is operated, as possessing the advantages set forth. 8th, Placing the vibrating mould arm, H, between the furnace and the propelling or cam shaft, as described.

2. Machinery for Making Barrels and other Casks; Isaac Crossett, Bennington, Vermont; patented July 1, 1844; re-issued March 2, 1858; extended June 26, 1858.

Claim—The vibratory block or bed, adjustable gauge, and knife or cutter, arranged relatively with each other, so as to operate as set forth.

Re-Issues.

1. Method of Ventilating Ships, &c.; Rudolph Knecht, City of New York; patented November 11, 1856; re-issued July 6, 1858.

Claim—The ventilating of vessels, houses, rooms, or any other description of enclosed and covered spaces by expelling the foul air contained therein, and by simultaneously introducing in its stead fresh air, cooled air, by a combination and arrangement of two sets of wings on one shaft, acting simultaneously.

2. Machines for Marking Time of Attendance of Workmen; Benj. T. Harris, Assignor to John McKillap, Assignor to Mary E. Harris, Brooklyn, New York; patented August 11, 1857; re-issued July 6, 1858.

Claim—The combination of a registering surface operated by clock-work, with markers so applied as to mark on said surface, and indicate the presence or absence of the employee or workman at or from the period of time denoted by the position of the registering surface. Also, a perforated plate, in combination with a slide, or its equivalent, whereby the presence or absence of the employee or workman to whom each perforation is alloted, is indicated, upon inspection, by means of black and white, or dissimilar colors, exhibited behind said openings.

3. SEWING MACHINES; W. O. Grover, Boston, and W. E. Baker, Roxbury, Assignors of the Grover & Baker Sewing Machine Co., Boston, Massachusetts; patented June 22, 1852; re-issued July 6, 1858.

Claim—1st, In combination with an upper needle or eye-pointed perforating instrument, a non-perforating eye-pointed instrument, so shaped and moved that it shall spread a loop of the thread it governs, while advancing through a loop of the upper needle thread. 2d, In combination with an eye-pointed upper needle, a non-perforating instrument having the function of carrying the loop of the upper needle thread out of the location or position in which it was originally seized. 3d, In combination with an eye-pointed instrument, an eye-pointed non-perforating instrument, such as described, and performing the two offices of spreading a loop of its own thread while advancing through a loop of the upper needle thread, and of changing the locality of the loop of upper thread that it has seized, both offices being performed in the manner described. 4th, An eye-pointed, upper needle and an eye-pointed needle, so arranged and operating as to make a stitch substantially such as is represented, in combination with a feed apparatus, one surface of which has motion in four different directions, in the manner described.

4. SEWING MACHINES; John A Ruckman, Assignee of J. E. A. Gibbs, Millpoint, Virginia; patented June 2, 1857; re-issued July 13, 1858.

Claim—1st, In the single thread sewing machine, I claim a hook or looper, revolving in one direction only, being so constructed as to make a series of chain stitches, when operating in connexion with a reciprocating needle. 2d, The peculiar construction of a revolving hook, whereby while one loop is taken from the needle by the hook, spread, twisted, and held in the path of the needle until another or fresh loop is taken, the former loop shall be released and drawn up during the retreat of the needle.

5. MACHINE FOR FOLDING PAPER; S. T. Bacon, Assignee of A. Hardy, Boston, Massachusetts, Assignee of J. North, Middletown, Connecticut; patented April 15, 1856; re-issued June 27, 1858.

Claim—1st, Producing the fold over a stationary knife or straight edge by pressure upon the sheet, when in contact with the knife edge. 2d, The use of nippers so constructed as to fold the sheet over the knife edge, seize it and carry it to its proper position for receiving another fold. 3d, The method for releasing the sheet from the nipper. 4th, The adjustable check and the mode of releasing its hold by the advance of the nippers. 5th, Attaching the stationary knives to the reciprocating carriage. 6th, The combination of the crank, slotted connecting rod, lever, and link, for operating the reciprocating carriage. 7th, Hanging the cutting rollers on a bar vibrated and checked as described. 8th, The arrangement of the levers with double concentric shafts for operating the nippers from one cam.

6. CASTING SKEINS FOR WAGONS; Andrew Leonard, Kenosha, Wisconsin; patented February 24, 1857; re-issued June 27, 1858.

Claim—The combination of a whole thimble skein pattern with a loose collar pattern. Also, the vertical position of green sand cores for thimble skeins, when moulded and combined at their base with the mould, in the manner specified, in combination with the adjusting top of the cores by the hand, after the mould is completed, except the case, whether core bars, or their equivalents for the purpose, are used.

DESIGNS.

1. TYPES; James Conner, City of New York; dated July 6, 1858.
2. PRINTERS' TYPES; James Conner, City of New York; dated July 6, 1858.
3. PRINTERS' TYPES; James Conner, City of New York; dated July 6, 1858.
4. RANGE FRONTS; A. C. Barstow, Providence, Rhode Island; dated July 6, 1858.
5. BEDSTEADS; Heinrich Neidig, City of New York; dated July 13, 1858.
6. COOKING STOVES; E. J Delaney, Philadelphia, Assignor to H. E. Marsh and Joseph Johnson, Lawrenceville, Pennsylvania; dated July 13, 1858.
7. STOVES; N. S. Vedder, Troy, Assignor to George W. Eddy, Waterford, New York; dated July 13, 1858.
8. STOVES; Garrettson Smith and Henry Brown, Assignors to J. G. Abbott and A. Lawrence, Philadelphia, Pennsylvania; dated July 20, 1858.
9. PITCHERS; George W. Smith, Hartford, Connecticut; dated July 20, 1858.

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Contributions to Metallurgy, No. 1. By FREDK. A. GENTH, Ph. D., Consulting Chemist and Metallurgist.

The difference in the appearance of a lot of Chinese coins, which were lately offered for sale in this city by a native of the Celestial Empire, and the little knowledge which we have on the subject of Chinese metallurgy, suggested the idea, that by a careful examination of the different kinds, some new and serviceable alloys might be added to those already used in the arts; or, at least, that by such an investigation, some information might be obtained of the Chinese ores, and the manner of their reduction. With the exception of three or four alloys, which have been repeatedly analyzed, we know hardly anything of the

metallic compositions used by the Chinese. I have endeavored to learn from the works, written on China, how their alloys were manufactured, what kind of ores they use for that purpose, whether they prepare their alloys directly from the ores, or by mixing the metals in the proper proportions, etc. Unfortunately, I have not been able to consult many books, and these have frequently given statements, which, on account of the want of familiarity with metallurgy of their authors, are unquestionably erroneous. So we find that different authors use not unfrequently the same name for altogether different substances.

The white copper of the Chinese, more than any other metal or alloy, appears to have attracted the curiosity of the writers on China. John Francis Davis,* who generally seems to be very well informed, speaks of it as an alloy of copper, zinc, and iron, with a little silver, and occasionally some nickel. The process of its manufacture, as he gives it, however, directly from the powdered ore, mixed with charcoal dust, and placed in jars over a slow fire, and the vapors condensed in water, leaves no doubt that the Chinese furnished him with their method of distilling zinc.

Of the same substance speaks undoubtedly Father Mailla,† who observes that the Chinese, besides the common copper, have another one of a white color, which is obtained directly from the ore, and is called Pe-tong.‡ He describes it as being whiter on the fresh fracture, but very brittle and hard, and mentions it as being frequently used in China; that it is necessary, however, to add Tutanegue or some similar metal to it, in order to render it soft and less brittle. The meaning of Father Mailla's Tutanegue is unintelligible. The word Tutanegue, or Tutenag, means zinc,§ but it is frequently, although erroneously, used for an inferior alloy of copper, zinc, and nickel. The richest alloy, composed of these three metals, the real Pack-fong, or, more correctly, Pack-tong, is undoubtedly the most interesting of all. The best kind, which contains nearly 32 ℔ cent. of nickel, has the color of silver of 18 carats; this alloy is sometimes called Electrum. There exists however in China a good many varieties, which contain a great deal less nickel. They are too well known to require repetition.

Another very interesting alloy is that from which the gongs are made, the so-called Tam-Tam metal. It contains about 80 ℔ cent. of copper and 20 ℔ cent. of tin. This composition seems to have been in use for many hundreds, perhaps thousands of years, for an ancient cast coffin, found on the east side of the Altai mountains, near the boundary line of China, gave on analysis the same substances, in almost exactly the same proportion. Of the other alloys of tin and copper, that which is called Chinese silver, and which is used for mirrors, is the most interesting; we have no analysis of it; but it has in all probability the same composition as our speculum metal, which is used for the construction of mirrors of telescopes or similar purposes; Davis says that it contains tin and copper, and perhaps a portion of silver.

* The Chinese. By John Francis Davis. New edition, London, 1851.
† Histoire générale de la Chine; traduite du Tong-kien-kang-mon. Par le Père Mailla.
‡ According to Stan. Julien (Compt. rend. xxiv, 1069) Pé-tong is an alloy of copper and arsenic.
§ Handbuch der Technischen Chemie von Ernst Ludwig Schubarth—Berlin, 1851.

Father Mailla states that the alloys used for coins are made from the materials furnished, since a very long period, from the provinces Yun-nan and Koei-tcheou. The coins are called Tschen, and are, according to Davis, composed of copper and zinc, with perhaps some lead. These are the only coins issued by the Chinese government, and their value should be equal to one-thousandth of the Chinese silver ounce or tael, which latter is equal to $1·40 of United States money. Their market value however was, when Davis made his observations, equal to 1240 tschen for one tael fine silver, although the expense of their manufacture was frequently greater to the government, so that the Viceroy of Fokien, in a memoir to the Emperor, suggested to close the mint of that province, and suspend the coinage altogether, until the relative value of Tschen and silver would approach nearer to a par. Although the value of one Tschen is not more than about one-tenth of one cent of our money, and the inducements to counterfeit the same cannot be very great, still the Chinese cannot resist their unconquerable propensity of substituting something of an even smaller value, that they forge them and smuggle casts of lead into circulation. The Tschen have an inscription on both sides: on one the name of the reigning Emperor, with two words denoting "current value;" on the reverse, a Tartar inscription. They have a square hole in the centre, through which they are strung together by hundreds to save counting. Most of the coins which I have seen were of this description, and they are certainly the most common. However, there are two other kinds, which are not mentioned by Davis, and of which I am therefore in doubt, whether they are government's issue, viz: of cast iron, and of an alloy principally of lead and copper. Of the cast iron coins I have seen only one. It had a square hole in the centre, like the Tschen, and similar inscriptions on both sides. It is very hard, but was so much oxidized that it was impossible to examine more closely into the nature of the metal. The other coin appears to be the same, of which Renouard de St. Croix speaks,* and of which he says, that it is called Patéc, is made of an alloy of copper and lead, has a square hole in the centre, and only on one side an inscription. The analyses, No. 7 and 8, are in all probability this coin: it was impossible, however, to observe any inscription on either side, but as they are made of a very soft alloy, this may have been worn off.

All the Chinese coins are casts, and are not struck or stamped. Many of those, which I have examined, showed the impression of the fine sand used for the moulds; others were hollow, others did not fill the mould completely, or were full of very minute cavities and air-holes; hence the specific gravity was in some found to be considerably smaller than it ought to have been.

A pupil of mine, Mr. George J. Pöpplein, of Baltimore, has at my suggestion made in my laboratory the following very careful analyses of the various Chinese coins.

The analytical methods adopted did not materially differ from those generally in use. It was found, however, that tin cannot be accurately determined by dissolving in nitric acid, etc. It was therefore always sepa-

* Renouard de St. Croix' Voyage, vol. iii.

rated in the usual way, but the binoxide of tin was afterwards decomposed by fusion with sulphur and carbonate of soda, by which method the small quantities of lead, silver, copper, and iron were converted into insoluble sulphides, whilst the bisulphide of tin and sodium was dissolved by water, etc. All the necessary precautions were also taken, to insure a complete separation of the zinc from the copper. The following are the results of Mr. Pöpplein's analyses:

No. 1. *Tschen.*—Color, pale brass yellow, greyish on the fresh fracture; very good cast, with very fine grain, and but very few air-holes inside; exceedingly brittle. It contains:

Copper,	=	63·94 per cent.
Tin,	=	2·29 "
Lead,	=	6·02 "
Zinc,	=	26·24 "
Cobalt,	=	trace.
Iron,	=	1·35 "
		99.84

No. 2. *Tschen.**—Color, pale bronze yellow; the composition was not homogeneous, and with the magnifying glass two alloys, one of a brass yellow, the other of a pale copper-red color, could be distinguished; the color of the fresh fracture was greyish; medium grain, brittle. It contains:

Copper,	=	60·97 per cent.
Tin,	=	0·05 "
Lead,	=	1·56 "
Zinc,	=	35·05 "
Iron,	=	2·37 "
Silver and Cobalt,	=	traces.
		100·00

No. 3. *Tschen.*—Thick brass yellow coin, very good cast of fine grain; not easily tarnishing. Sp. grav. at 25° Cels. = 8·497. It contains:

Copper,	=	55·53 per cent.
Tin,	=	0·33 "
Antimony,	=	3·21 "
Arsenic,	=	3·44 "
Lead,	=	1·03 "
Zinc,	=	32·74 "
Nickel,	=	0·54 "
Iron,	=	2·38 "
		99·20

No. 4. *Tschen.*—Brass yellow, with a greenish tinge, a very good cast; fine grain, brittle; easily tarnishing. It contains:

Copper,	=	59·14 per cent.
Tin,	=	2·71 "
Lead,	=	3·40 "
Zinc,	=	29·62 "
Iron,	=	4·83 "
Nickel,	=	0·17 "
Cobalt and silver,	=	traces.
		99·87

* H. Onnen (Scheik. Onderz. iv. 517 ff.) has analyzed a similar alloy from China, of a copper red color.

No. 5. *Tschen.*—Bronze yellow, greyish on the fresh fracture. Spec. Grav. = 8·552. It contains:

Copper,	=	59·983 per cent. (from the loss.)
Tin,	=	1·204 "
Silver,	=	0·068 "
Lead,	=	3·977 "
Zinc,	=	32·114 "
Nickel,	=	0·552 "
Iron,	=	2·102 "
Arsenic,	=	trace.
		100·00

No. 6. *Tschen.*—Color, bronze yellow, the fresh fracture brass yellow; the grain is coarse and crystalline, with many cavities; did not fill the mould well; very brittle. Spec. Grav. = 8·166. It contains:

Copper,	=	60·19 per cent.
Tin,	=	1·81 "
Lead,	=	5·83 "
Zinc,	=	31·57 "
Iron,	=	1·34 "
		100·74

No. 7. *Patéc.*—Not homogeneous, but a mixture of a grey and pale copper-red alloy; full of very small cavities, cuts easily with the knife; brittle. Spec. Grav. = 8·517. It contains:

Copper,	=	59·88 per cent.
Tin,	=	7·90 "
Lead,	=	31·42 "
Zinc,	=	0·59 "
Nickel,	=	0·18 "
Iron,	=	0·35 "
Silver, Arsenic, and Antimony,	=	traces.
		100·32

No. 8. *Patéc.*—Similar to No. 7, but of a coarser grain. Spec. Grav. above 9. It contains:

Copper,	=	51·20 per cent.
Silver,	=	0·03 "
Tin,	=	4·81 "
Lead,	=	42·25 "
Cobalt,	=	0·23 "
Iron,	=	1·36 "
Zinc and Nickel,	=	traces.
		99·88

From these analyses, it is difficult to come to any general conclusions, because the Chinese are not guided by certain and invariable rules in the manufacture of their coins, although they generally use a composition which might pass under the name "brass." This brass is certainly made by mixing copper and zinc together, and only seldom directly from the ore, as the ancients have done. We know, from the descriptions given by Father Mailla and J. F. Davis, that they make zinc, and also know that long before the manufacture of zinc came into use in Europe, the Dutch brought it from China. The copper, which is used for their coins, appears to be always very impure, and is evidently made from ores containing iron, sometimes with small quantities

of nickel and cobalt; analyses, Nos. 3 and 7, indicate the occurrence of antimonial and arsenical grey copper (Tetrahedrite) in China. Frequently, it seems, that the Chinese take at hap-hazard, what of alloys and metals they can get, melt it together, and cast their coins from that mixture. We have seen above, that alloys of copper and tin are frequently used in China; now it seems that they add invariably a small quantity of such alloys for the manufacture of their coins, because every analysis shows the presence of tin; but we know that ores of copper, containing tin at the same time, are not frequently met with.

It is very probable that the Chinese have had the same kind of alloys in use for perhaps more than two thousand years; it was of interest, therefore, to compare the composition of some ancient Roman coins with that of Chinese coins. I have been permitted by Rev. H. S. Osborn, for whom I have made analyses of coins of the Emperors Hadrian and Trajan, for his work on Palestine, Past and Present, to insert these in this paper.

No. 9. *Hadrian Coin.*—Of a bronze yellow color; the color on the fresh fracture is inclining to brass yellow; grain very fine. Spec. Grav. = 8·778. It contains:

Copper,	=	86·92 per cent.
Silver,	=	0·30 "
Tin,	=	0·72 "
Lead,	=	1·10 "
Zinc,	=	10·97 "
Iron,	=	0·18 "
Arsenic and Antimony,	=	traces.
		100·19

No. 10. *Trajan Coin.*—The color is bronze yellow, inclining to brass yellow; the fresh fracture is greyish; very fine grain. Spec. Grav. = 8·745. It contains:

Copper,	=	88·58 per cent.
Silver,	=	0·21 "
Tin,	=	1·80 "
Lead,	=	2·28 "
Zinc,	=	7·56 "
Iron,	=	0·29 "
		100·72

Both coins were stamped, and not cast like those from China, and both were pretty tough, which is certainly owing to the smaller percentage of zinc and iron in the same. These alloys were beyond question made directly from the ore, and only the small percentage of tin appears to have been added afterwards.

Philadelphia, 6th September, 1858.

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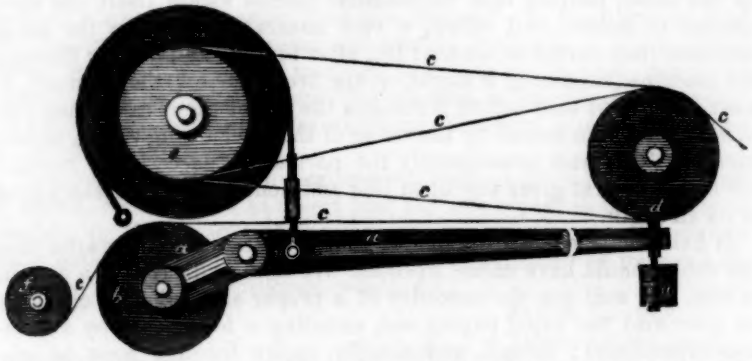
*The Atlantic Cable Apparatus.**

GENTLEMEN:—We beg to draw your attention to an apparatus we have invented for paying out telegraphic cables. Our object has been to render it impossible to have a greater strain on the cable than that

* From the London Mechanics' Magazine, July, 1858.

to which the machine might be set, no matter how much the ship might pitch or roll. This we confidently believe we have accomplished, by making use of that force which now snaps the cable in two, causing it to ease the breaks, and thus allow the cable to run free so long as an excessive strain continues. This can be easily made plain on inspection of fig. 1. *a*, *a*, is a lever carrying a weight, *w*, at one end and a friction pulley, *b*, at the other. The cable, *c*, *c*, *c*, on coming from the hold passes over the pulley, *d*, on to the pulley, *e*, which carries a break connected to the lever, *a*, *a*. It finally passes over the pulley, *b*, and under

Fig. 1.



the pulley, *f*, into the sea. Now, the principal feature of our invention is this:—Whenever the strain on the cable is such that it causes a downward pressure on the pulley, *b*, greater than the balance weight on the other end of the lever, *a*, *a*, has been adjusted to resist, the pulley, *b*, must descend, the break end of the lever must rise, and the pulley, *e*, is left free to go round. The use of the pulley, *f*, is to maintain a constant angle between the cable going on to the pulley, *b*, and leaving it; otherwise the strain on the pulley, *b*, would not correspond with the strain on the cable.

Fig. 2 shows our break-relieving apparatus, which we have contrived in pursuance of the same principle, to be applied to the machinery now on board the *Agamemnon* and *Niagara*. Here, when the excessive strain comes on the cable, the pulley, *b*, descends, and a strain is put upon the rod, *g*, which may be used to take off the breaks from the pulleys, *h*, *h*, of the old machine. Although we have shown this

Fig. 2.

last application, we do not recommend it equally with the arrangement before described, but place it before you merely to show how the principle could be applied with the present machinery. A very slight inspection will show the superiority of fig. 1 in its entirety to the one in question (fig. 2).

It needs but few remarks to show to your readers, and to the shareholders in particular, the tremendous risk that is run by allowing a machine to be used which, in its very nature, allows the cable to receive the destructive strain before it can be recorded by the indicator, or the attendant on the breaks knows it is necessary to release them. This serious defect must be obviated, for the cable should never for an instant be suffered to endure more strain than is desired.

We here beg to draw your attention to the report of the trials, for the purpose of illustrating our argument. It will be seen that, with a pressure upon the breaks of 2000 lbs., the indicator recorded 6000 lbs. on the cable, proving that the machine carries within itself the very essence of failure, and affords a very natural reason why the cable has sometimes parted in the sea; for, after tugging and tearing through the machine (supposing it might escape breakage for the moment), it must be obvious that before it reaches the bed of the ocean it has still to bear the strain caused by the rising of the discharging vessel, undercurrents, &c.; and consequently the part which successfully resisted the strain at first gives way upon this additional and unnecessary trial of its strength.

It has been suggested by one of your scientific contemporaries that the cable should have entire freedom. We agree with this to a certain extent, but still see the necessity of a proper and judicious check on its otherwise too rapid paying out, entailing a heavy loss by a needless expenditure; though, undoubtedly, entire freedom must be submitted to in the sudden and dangerous movements which of necessity will exist.

The important provision for safety, by allowing the cable to run free at the critical periods of its passage to the sea, we feel confident would be attained by the use of the principle we have now the honor to submit to you; and we have no doubt that, being now fully open to your criticism and that of your numerous scientific readers, the defects, if any, will be fairly shown. It is possible that, in carrying out the details, alterations in the disposal of the breaks and pulleys might be found necessary, but the principle of the machine we submit with confidence as the only one by which the much-desired instantaneous freedom can be given. Experiments would fully prove the truth of our assertion, but our humble position prevents our being able to test it by such means.

Believing that the splendid idea of conveying a channel for thought through the mighty waste of waters demanded the attention and cooperation of all men, we applied ourselves assiduously to the task of devising a machine combining within itself all the requirements of so important a preliminary. The result of our united efforts we have now the honor to lay before you, a description of the same having been previously published in the *Times* of the 18th September last, in a letter signed "Two Working Mechanics," and was also communicated to the Atlantic Telegraph Company, to whom a model was also exhibited; but, while eliciting the warmest approbation from many gentlemen of high scientific attainments, some in connexion with the Com-

pany and some not, it was only partially adopted by an approach to the principle of self-action; whereas, to be effectual, it is necessary to combine the whole in the manner now shown.

The growing desire and absolute necessity for the establishment of telegraphic communications to all parts of the world, render it imperative that in order to avert the sacrifice of so much valuable time and capital in the important preliminary of submerging the cable (such, for instance, as we have witnessed so recently in the case of the Atlantic Company), those who are charged with the onerous duty of supervising the operation should endeavor to avail themselves of the wisest counsels it is possible to procure, regardless of the source from whence derived, whether emanating from the brain of the hard-handed sons of labor, or their more eminent and learned brethren. It is but simple justice to those who have invested their capital in such important schemes, that no jealousy should be allowed to intervene to prevent the adoption of such a plan as would in all human probability secure the great end in view.

Disavowing any desire to condemn in a factious spirit the productions of others, we beg leave to assert that our sole object is to conduce, if possible, to the success of the gigantic enterprise now immediately under notice, or to any similar one that may hereafter be undertaken.

We are, gentlemen, yours, &c.,

JAMES MATHER,
THOMAS RICHARDS.

Woolwich, 19th July, 1858.

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*On an Improved System of Moulding and Casting.** By R. JOBSON.

Amongst the few roads left open for improvement in the economy of moulding, increased rapidity of production appears to be the most available; but advantage can rarely be taken of this, except where there is great repetition in the article required, as in the case of railway chairs in all their varieties, shot, shells, castings for agricultural implements, pipes, troughs, stove and fender castings, &c. It is to this class of work, accordingly, that the moulding machine forming the subject of the present paper is more specially applicable.

The general construction of this moulding machine may be thus described:—There is a moulding table or bed, consisting of a rectangular cast iron box, open at top and bottom, and furnished with a large cylindrical axis at each end, turning in bearings on the side frames. The axes are prolonged at the ends, and counterbalance weights are attached to them by arms, which can be readily adjusted by lengthening or shortening, so as to balance the table with the mould upon it, leaving it free to turn upon the axes. To this table is fixed a plate, for carrying the moulding box, which is secured thereto by two inclined catches with handles. This plate forms the ramming board, upon which the pattern is fixed, and the moulding sand rammed upon it in the ordinary way. The machine is shown as arranged for moulding 8-inch

* From Newton's London Journal of Arts and Sciences, August, 1858.

shells, the pattern being a hemisphere; any pattern or form of flask within the limits of the size of the machine can, however, be readily employed, the only preparation requisite being to fix each pattern upon a bottom plate, having bolt holes to correspond with those in the top of the moulding table. This arrangement is so simple, that after the machine has been moulding shells, it can be changed and got to work again at moulding railway chairs or other articles within 10 minutes time.

As soon as the sand is rammed, a cover plate is put on the box, by sliding it on the inclined snugs, which hold it fast; the whole is then turned over with the moulding table into the reversed position; this being effected by the simple pressure of pushing home the cover plate, since the whole is balanced, and turns freely upon the axes. In moulding shells, the pattern is then withdrawn from the mould, sufficiently to make it clear the sand, by means of a screw and hand wheel, with which the pattern is connected. A rising platform, which slides in vertical grooves in the side frames, is then brought up, by means of a lever, to touch the cover plate of the box, which is now at the underside, and the box is liberated from the moulding plate by releasing the holding catches simultaneously. The platform, with the moulding box, now descends (by reason of the additional weight upon it) to its normal position, the platform being counterpoised by balance weights. The mould is then removed, by sliding it off the platform on to a little railway placed at the same level; and the machine is made ready for repeating the operation, by screwing down the pattern to its right place, and turning back the moulding table to its former position, ready to receive a second empty box.

The principle carried out in this machine, of turning over the whole moulding table, with the mould and pattern upon it undisturbed, has the effect of saving all labor of lifting the moulds; so that boys, who are sufficient for all the actual moulding work, are able to complete the process, instead of men being required to lift the heavy weights. An advantage in average quality of work, and saving of wasters is obtained, by avoiding all handling and risk of disturbing the moulds in lifting them off. They simply slide along a little smooth railway from the moulding machine to the casting ladle, which is fixed within 7 feet 6 inches distance from the moulding machine, centre to centre. A very important point is also gained by always replacing the pattern in its first position while still inverted, thus preventing any particles of sand from interfering with the working parts of the pattern.

The result of the working of the moulding machine is so successful, that one mould, consisting of two railway chairs, is readily completed every minute on one machine; and the machine is found to keep so completely in working order, that the regular day's work of 10 hours produces from 1000 to 1100 chairs, being at the average rate throughout of two chairs per minute. This extraordinary rapidity of moulding by the machine could not be made fully available with the ordinary means of casting, on account of the large floor space required for casting with the necessary rapidity, and the consequent delay and expense

attending the removal of the moulds over that space; and a great objection experienced at first, in regard to economy of work, was the large number of moulding boxes to keep even one machine going at the full rate. To meet these difficulties, a casting apparatus was designed by the writer, which is fixed close to the moulding machine: this is capable of filling the moulds as fast as they leave the machine, so that no loss of time or space occurs; and within two or three minutes the whole operation of moulding and casting is completed in each case, and the box laid out in the open air to cool, ready for emptying and using again on the machine within about six minutes time.

The ladle is placed in a standard frame upon the floor, the sides of which partly embrace the front of the ladle, and are connected together, at their extremities by a spindle, which passes through two corresponding lugs, fixed on the front of the ladle, just below the lip. This spindle forms an axis, upon which the ladle turns when pouring, and the ladle is lifted by means of a shaft fixed under the centre of the ladle, and connected by links to two hand levers, which are fixed to a common cross shaft. The weight of the loaded ladle is counterpoised by balance weights, connected by chains, which are carried over elevated pulleys to the shaft that passes under the ladle. From the position of the spindle on which the ladle turns, the lip of the ladle follows the direction of the stream of metal all the time that the ladle is being turned to its extreme position, so that the position of the stream of metal is stationary in all positions of the ladle; the several moulds are therefore only required to be brought to the same spot in succession, and the metal can be poured in at once, without any delay for adjustment of position; the moulds being filled as fast as they can be brought up to the ladle from the moulding machine. The command over the movement of the ladle, given by the hand levers, makes the pouring of the metal very steady; and the whole being nearly balanced, the caster tilts the ladle with one hand, whilst he skims the metal for himself with the other. A supply of fresh metal is brought from the cupola at regular intervals by a couple of laborers, with an ordinary double-handled ladle.

In casting railway chairs by the old system, it was considered a good day's work to obtain 300 castings from one man and his boys; and with the best plan the average does not exceed 480 per day.

With regard to the casting:—by the ordinary plan of carrying the iron and pouring it into the moulds, for casting railway chairs, six men and three boys were required to each table, and a long length of rails, together with a much greater number of boxes; but by the new ladle one man is enabled to cast all that can be moulded on one table, and two metal carriers are sufficient for two tables; so that two men can, in this department, do the work of nine men and boys, and with less labor, since they have not to stand in a constrained position with a heavy weight, as they were compelled to do in filling the moulds by the ordinary hand ladles. Also, the equality of the heat of the iron is greater from its being constantly supplied; and its purity is increased by being stirred up every time the hot metal is poured into the ladle, which is

a very important consideration in casting shot and shells. The regularity with which the process is carried on keeps the ground constantly clear, without bustle or confusion, and no one appears overworked.

The moulding table has been applied to moulding the wedges for Parson's railway chairs, weighing 4 lbs. each, 10 in a box; and the result has been the production of 5000 wedges per day from a pair of tables, while, by the old process, only between 900 and 1000 wedges per day were obtained. The writer understands that, at Ipswich, the machine has been applied to moulding bullock pans; and the result is, that four times as many castings are produced, and of better quality than before.

The saving in boxes, and in the breakage inseparable from the old system, would, the writer considers, in a very short time, pay for the moulding table, casting ladle, and all other extra outlay; and the common charges or incidental expenses are brought down to a minimum. The foundry room required for one set of apparatus for moulding and casting chairs is only 22 feet by 14 feet, or about 300 square feet; thus enabling any foundry already built to produce at least three times as much work as before in the same floor space. No more skill is necessary for working the machine than can be taught in an hour, and strength is quite a secondary consideration; the cheapest class of labor is therefore available.

Proceedings Inst. Mechanical Engineers, London.

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*Description of Wrigley's Friction Coupling for Shafting.** By Mr. Benjamin Fothergill.

This plan of friction coupling, which is the invention of Mr. Francis Wrigley, of Manchester, consists of a double set of powerful levers, each set forming what is called a knuckle joint, directly applied to a friction surface in motion, which is, by that means, brought into easy and gradual contact with another corresponding surface at rest, and there firmly held in position by the levers, without any other retaining force. By the effect of this frictional contact, any required amount of power may be transmitted from the prime mover to shafting, gearing, or other machinery, which has alternately to be set in motion, or brought to rest; and this is accomplished silently, and without the slightest shock or concussion to any part of the shafting, gearing, or machinery.

The sliding box (which moves on two fast keys or feathers, let into the shaft, and to which is applied the forked lever, for throwing the coupling into and out of gear) is connected by coupling bars to a pair of side links, which connect two friction blocks together. These blocks are surrounded by an external friction ring, which is bolted to a bevel wheel, bored out to fit the shaft, and run free upon it. A strong circular disk, keyed fast on the shaft, carries the two segmental friction blocks, their connexion with the disk being by means of snugs cast thereon, which act as drivers as well as guides for the friction blocks to slide on. Fitted into the friction blocks are case-hardened bearings,

* From Newton's London Journal of Arts and Sciences, August, 1858.

against which the circular ends of the connecting links abut; and these are capable of being lengthened or shortened, by means of adjusting screws, acting against the case-hardened bearings, by an inclined plane, so as to adapt the pressure between the friction surfaces to the power required to be transmitted. By this method of adjustment, the slightest amount of wear on the friction surfaces, or in the joints, can be compensated for with the greatest accuracy.

When the friction surfaces are brought into permanent or working contact, they require no sustaining power to keep them there; for to accomplish this it is only necessary to bring the inner centres of the links into line with their extreme centres, thereby forming a column, having no tendency to move out of line one way or the other. In the transmission of power, say from 25 horse power upwards, it is considered advisable, when convenient, to work the forked lever by means of a coarse pitched screw, for the purpose of engaging and disengaging the coupling; but for the transmission of a smaller power, a common hand lever is quite sufficient.

With regard to friction couplings and their application generally, it may be observed, that they have not been so extensively used as is desirable, not only for the prevention of accident, but in cases where occasionally only a certain portion of the shafting or machinery in an establishment is required to be put in motion. It appears, however, desirable that, in all extensive works and manufactories, there should be a friction coupling at the commencement of every main line of shafting; for by their application it is not improbable that many accidents, which now prove fatal, might be considerably mitigated, if not avoided, as the means would be at hand for stopping a line of shafting, or a room of machinery, at a moment's notice, without the too often fatal delay consequent on giving notice to the engineer to stop the engine.

An application of this friction coupling may, it is thought, be made with advantage, especially in heavy driving, in place of the ordinary fast and loose pulley, in which a considerable economy in the wear and tear of straps or belts might be reasonably expected; as the necessity for traversing the strap backwards and forwards on to the fast and loose pulley would be avoided. In addition to which, a further saving would be effected in the strap pulleys themselves, the driving pulley being required only half the width of those at present in use; for the friction coupling or driving pulley answering the double purpose of fast and loose pulley, the latter would not be required. Friction pulleys for this purpose might be made at a comparatively small cost, as they would require only one set of double levers, with their inner ends forked, so as to encircle the shaft, and connect the side links or coupling bars to the forked lever.

In arranging this friction coupling, it has been attempted to combine powerful and efficient action, simplicity of construction, and an easy and accurate system of adjustment against wear of the friction surfaces, with effectual means of increasing the power transmitted to any limit within the strength of the materials acted upon, together with cheapness and durability of construction.

Proceedings Inst. Mechanical Engineers, London.

*Steel Ships.**

In December, 1850, Mr. Ewald Riepe obtained an English patent for certain improvements in refining steel, which were described in No. 1453 of this Magazine, p. 476.† They consisted mainly in subjecting bars or lumps of raw or crude steel to the action of heat for about four hours in a furnace closed to the external atmosphere, the temperature being kept a little below the melting point of the steel. By this method of operation, carburetted hydrogen and oxide of carbon are developed in the furnace in abundance, while the oxygen of the air is entirely prevented from acting upon the steel, the working door of the furnace, &c., being carefully luted for this purpose.

This patent, which was permitted to remain in abeyance for some time, has lately been worked with very beneficial results by Mr. William Clay, of the Mersey Iron works, the steel produced by means of it having been found to possess a very fine uniform grain, and to be peculiarly suitable for the plating of ships. A new steamer of 170 tons, named the *Rainbow*, intended for the Niger Expedition, has been constructed of plates of this steel at the building yard of Mr. J. Laird, of Birkenhead. She was tried on the Mersey on Saturday last, and is to sail for Africa this week. Her dimensions are:—Length, 130 feet; beam, 16 feet. The hull is subdivided, by athwartship and longitudinal bulkheads, into 10 or 12 water tight compartments, for giving her greater strength, and rendering her more secure against accidents. Her engine is high pressure and of 60 horse power, working up to 200 horse power, indicated; and the boilers, which have also been made of Mr. Clay's steel plates, have been proved up to 200 lbs. on the square inch, though they will only require to be worked at 50 lbs. to 60 lbs. The engine and boiler, as well as the hull, have been constructed by Mr. Laird. The advantage of employing this material over the ordinary iron plates is that, with about half the thickness, they are said to give equal strength with the best iron boiler plates, so that vessels are able to be constructed of considerably lighter draft of water than formerly, a result which is likely to be of incalculable benefit in the navigation of the shallow rivers of Africa and India. It will be remembered that Dr. Livingstone took out a small steam yacht the plates for which were formed of the patent homogeneous metal, manufactured by Messrs. Shortridge, Howell, and Jessop, of Sheffield. The advantage claimed for the Riepe steel is that, while possessing equal strength and adaptability for the purposes of ship-building, it can be more economically produced. Indeed, it is said that the process of manufacture is so simple, and the cost so little in excess of that of ordinary iron, that, by the saving of weight in the material, as compared with iron of equal strength, it will become absolutely cheaper. *Apropos*, of the strength of the steel, we may state that recent experiments, made by Mr. Clay in testing, at the Liverpool Corporation chain-proving machine, some samples of steel bars manufactured at

* From the London Mechanics' Magazine, July, 1858. † See page 277.

the Mersey Works, showed that their average tensile strength was 160,832 per square inch, while the strength of Russian iron is only 62,644; of English rolled iron, 56,532; Lowmoor, 56,103; American hammered, 53,913; of tempered cast steel, 150,000, &c.

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*Church of St. Isaac, at St. Petersburg.**

The consecration of the Church of St. Isaac, at St. Petersburg, took place on the 10th of June. It was performed with all the Imperial ostentation and military pomp usual on such occasions. The pageants and processions were grand; and good seats, at a window favorably situated, were paid for as high as 150 silver roubles each. "Mixing with the thousands who wonder at the splendor of this gorgeous temple, our eyes," says a correspondent, "are dazzled with the profusion of barbaric pearl and gold they meet at every glance. We see no wood, except in the doors; all the rest is granite, Carrara marble, iron, porphyry, malachite, alabaster, lapis lazuli, bronze, silver, and gold. Even the lightning conductors are of platinum. The five crosses, as well as the cupola of the building, are guilt with a mass of 274 pounds of gold, and are seen glittering at a distance of 40 wersts from St. Petersburg. One of the bells weighs 75,000 pounds. 112 granite columns, with Corinthian capitals, surround the building. They are each 56 feet high, and 7 feet in diameter at the base. Each is considered to be of a value of £1800 English money. The cost of the whole magnificent building is reckoned—though this is probably a gross exaggeration—at £13,-500,000. The interior,—comprising a space of 60,000 square feet, and taken up neither by seats nor by organs (in the place of the organ there is a choir of 1000 men's voices),—is very imposing. The St. Isaac's Church has been thirty-nine years building. The aged, but still very active architect, M. Montferrat (who, at the consecration, followed in the Emperor's procession), has received a present of 40,000 silver rubles, besides a pension of 5000 silver rubles annually, which will also be paid to his widow, a picture of the Cathedral worked in gold and set with diamonds, and, lastly, the rank of a real Counsellor of State.

For the Journal of the Franklin Institute.

Atlantic Telegraph.

The subjoined Memorial was presented to Congress, as stated in its heading, upon the 29th of January, 1849. It contains the *first developed plan* ever promulgated for a telegraphic communication across the Atlantic Ocean. Horatio Hubbell, a citizen of Philadelphia, was its original projector and author of the memorial; he was joined by Col. John H. Sherburne in bringing it before Congress and the public.

The Memorial speaks for itself—the existence of a table land or plateau is there distinctly announced—and it is there first designated

* From the Lond. Athenæum, July, 1858.

as the spot for laying down the telegraphic connexion, as it has since been carried out, &c. The soundings and surveys of Lieut. Berryman, in the summer of 1853, more than four years after the Memorial had been published, fully corroborates its positions. A report upon the soundings of Berryman, and others, was made by Lieut. Maury, under date of 22d of February, 1854. But no personal survey was made by the latter.

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The following memorial was presented to the Senate of the United States by the Vice-President, the Hon. GEORGE M. DALLAS, at the Session of 1849, (XXXth Congress,) and to the House of Representatives by the Hon. JOSEPH R. INGERSOLL. In the Senate it was referred to the Committee on Commerce. In the House to the Committee on Naval Affairs. See Senate Journals for the second Session of the Thirtieth Congress, page 157, Monday, January 29, 1849. Also, the Journal of the House of Representatives, second Session of the Thirtieth Congress, page 337.

[Certified copy of the Memorial presented to the Senate.]

MEMORIAL.

To the Honorable the Senate and House of Representatives of the United States, in Congress assembled:—

The memorial of Horatio Hubbell and John Henry Sherburne, respectfully sets forth:—

That they are desirous of establishing a telegraphic communication between this Continent and Europe. Believing this to be practicable, from many substantial reasons, they ask your honorable bodies to appropriate means by which this great project may be successfully carried through. *Your memorialists proceed to say, that from many observations which have been made, there is incontestible evidence of the existence of a submarine table land, extending from the Banks of Newfoundland across the Atlantic Ocean to the mouth of the British Channel.* This is proved by the altered color of the sea water, which has a different appearance in unfathomable places from what it has in shallow spots. This, combined with the volcanic construction of Iceland and the Azores, and the situation of that portion of the ocean that lies between both these volcanic groups, has led to the conclusion that there has been a lifting up of the bottom of the sea, through the agency of a Plutonic power, and that the bottom thus elevated appears to be cut through in many places by deep water channels. The appearance of Medusæ, Polypi, and other marine creatures seen upon the edge of the discolored water strengthens this opinion. Your memorialists propose that these suggestions should be further investigated, and that for this purpose they be furnished with a vessel, by a resolution of your honorable bodies, in order to make the necessary surveys and soundings. They also ask, if such shall be found to exist across the Atlantic Ocean, that they be furnished by the United States government with the necessary buoys, and the chains and anchors, in order to station the said

buoys at the necessary distances across the ocean, in order to establish a line of communication. The distance from Cape Race, in Newfoundland, to the headlands of Dingle Bay, in Ireland, being about 1900 statute miles, it would take only three hundred and eighty buoys, to have a buoy anchored every five miles the whole distance; while it is probable that a buoy at every 10 miles distance would be sufficient —in which case one hundred and ninety buoys would be enough. To these buoys a coated telegraphic wire would be attached, and sunk at such distance under water as would protect it from all molestation—while in the intervals between the buoys, the wire, if necessary, would be supported by cork floats attached to it.

Your memorialists think it unnecessary to enter into further details at the present time to show, for instance, what precautions would be adopted to prevent the chafing of the wires against the anchoring chains; or the means of diminishing the size of the buoys by sustaining their anchoring chains by lesser buoys or floats throughout the whole length of the chain, &c. The chief object of your memorialists at present being to direct the attention of Congress to this important subject—as your memorialists are of opinion that, though no soundings may be found, as indicated above, yet that buoys may be anchored by means of buckets, properly contrived and let down to a sufficient depth, so as to be clear of all currents moving on the upper surface, and supporting a column of water, while they re-acted on the water, so as to counterbalance the drifting movement of the buoys.

And this experiment, they pray may be fully tested; which, should it not succeed, contrary to the firm persuasion of your memorialists, will yet serve to elucidate several important phenomena. Your memorialists advert to the fact that the British Government are now about adopting the bold project of carrying the telegraph wire across the Irish Channel, and it remains for our Government, by their promptness and energy, not to allow themselves to be anticipated in the glorious enterprise of extending a telegraphic communication across the ocean itself.

All of which is respectfully submitted by your memorialists,

[Signed,] HORATIO HUBBELL,
[Signed,] JOHN HENRY SHERBURNE.

True copy, Y. P. PAGE,
Jan. 15, 1857. *Clk. in office Sec. Senate U. S.*

Specification of a Patent Granted to EWALD RIEPE, *for certain Improvements in Refining Steel.** (A communication.) December 5, 1850.

I take bars or lumps of raw or crude steel (particularly puddled steel), and in order to the refining of them, place them in a furnace or other heating chamber, out of the reach of any injurious action upon them

* From the London Mechanics' Magazine, June, 1851.

by the atmospheric air, and there subject them for a time to a temperature not exceeding the melting point of steel. I use for the purpose a welding furnace, such as is ordinarily employed in puddling iron, only that the bed is lowered and the grate brought from two to four feet below the level of the fire-bridge, and the ash-pit is provided with an iron door, by which it may be entirely closed when required. When the furnace is in full heat, I place the bars or lumps of raw or crude steel on the bed of the furnace, but at distances apart, so that they may nowhere touch each other; and during the whole of the refining process, the fire place is kept fully charged with coals or other fuel. Then, in order to exclude as much as may be the access of oxygen, I carefully lute any crevices there may be, in the working door or elsewhere, with wet clay, and so regulate the draft of the furnace by means of the ash-pit-door and flue-damper—closing them more or less, or altogether, as may be requisite—that the heat shall never attain to the melting point of steel. A sufficient practical test of this is furnished by the color of the flame, which is, with this view, carefully watched through an eye-hole in the working door. As long as it keeps of a dull or hardly red color, the heat will not be in excess of what is required. I usually put from 900 lbs. to 1000 lbs. of raw or crude steel, in bars 3 inches by 1½ inches, into a furnace of the ordinary size, and continue the operation for about four hours. By this method of operation, carburetted hydrogen and oxide of carbon are developed in the furnace in abundance, while the oxygen of the atmospheric air is entirely prevented from acting on the steel; and the product is steel of a very fine uniform grain.

And having now described the nature of the said invention, and in what manner the same is to be performed, I declare that I do not restrict myself to the use of any particular form of furnace, nor to the subjection of the crude or raw steel to the refining process in any particular quantities or of any particular sizes; but that what I claim is the refining of raw or crude steel (particularly puddled steel), by placing it in a furnace or other heating chamber, out of the reach of any injurious action upon it by the atmospheric air, and there subjecting it for a time to a temperature not exceeding the melting point of the steel.

Specification of the Patent Granted to CHARLES WESTENDARP, JR., *for Preparing a Material as a Substitute for Ivory, which he proposes calling "Artificial Ivory."**—Dated December 9, 1857.

My invention consists in manufacturing a material or materials which shall be made to imitate ivory, bone, horn, coral, or other similar substances, natural or artificial, and which may be used in preference to ivory and other such like substances, on account of cheapness and adaptability, as the same materials may be moulded or turned to the various forms or patterns they may be desired to take, and may be ap-

* From the London Repertory of Patent Inventions, No. 776.

plied (amongst others) to the following purposes, viz:—For billiard balls, door and other knobs, finger-plates, piano-forte keys, rulers, paper knives, knife and other handles, whip, stick, and other mounts, and in imitation or as a substitute for carved wood, enamelled china, precious stone works, and a variety of fancy, ornamental, and decorative work, such as figures, pilasters, mosaic pavements, panels, and other similar purposes, for which ivory, bone, coral, or such like articles are generally used, and, in order to explain my invention as completely as possible, I now proceed to describe the best means I am acquainted with for carrying the same into practical effect.

I take any certain quantity of small particles of ivory, bone, wood, glass, cotton, wool, or other similar articles, either in a coarse or fine powder, or in shavings, according to the imitation which is intended, and combine them or any of them, or any one of them, or all of them, or as many of them as I may see fit, according to the purpose required, with gums or other resinous materials, such as gum dammar, gum copal, resin, gum shellac, gum sandrac, wax, or other glutinous or resinous materials, also using which of the said gums I may see fit for the purpose the material is required for, either the whole of the said gums, or part, or any of them; these ingredients I combine by pressure or heat, or both, or with spirit, oils, or any similar vehicle or solvent, forming a mixture of the whole, or any of them, by mollifying, dissolving, or compressing the said small particles, with the said glutinous or resinous materials, thereby producing a substance of an ivory or wood-like appearance, which may be colored, dyed, or stained, during the process of manufacture or afterwards.

By the combination of the articles aforesaid, a paste will be obtained, which may be immediately moulded, and become solidified in a short space of time by means of heat or pressure, or both, or it may be so manufactured as to remain in a pasty condition for a considerable time, in order to allow it to be carried to any distance, or worked into any form, for instance, such as decorating in buildings, for mouldings, scrolls, or similar ornamental work; the hardening or drying materials being added at pleasure, according to the requirements of the work which is being performed.

The application of the material called "artificial ivory," may be very various besides those already named, as it is capable of being made to resemble sculptured articles, by means of dies or chasing, or it may be turned, carved, sawn, and polished, like ivory, bone, or other similar substances. In giving a precise description of the manufacture of the artificial ivory, I consider it will be sufficient to explain the method of making white billiard balls, as the various articles admit of such trifling variations that every one skilled in any handicraft can easily reproduce them. For example, I soak ivory dust, say five ounces, and a white color, say white lead or zinc white, three ounces, in a solution of eight ounces of white shellac or copal in sixteen ounces of spirit of wine. After the whole is well mixed, which is best done at a temperature a little below or above the boiling point of water, the alcohol is partially or wholly evaporated, and the stiff paste or dry powder pressed into a

solid mass in a pair of dies or mould, which have been previously heated to about 230 to 280 degrees Fahrenheit; after being so solidified, they are worked round and polished like the ordinary ivory balls. The same purpose is effected by reducing eight ounces of white shellac, three ounces of white color prepared of bismuth, lead, or zinc, with five ounces of ivory dust, bone dust, or any other suitable matter, into a fine powder, and by mixing this powder in passing it between heated metal rollers repeatedly, at about 230 to 280 degrees Fahrenheit; by this process a soft homogeneous mass is obtained, which can easily be moulded into any desired shape, and forms, when cold and hard, a very ivory-like material. Instead of using ivory dust, steamed and finely powdered bones, porcelain, cotton, and various finely powdered materials may be employed, and the colors may be varied according to the tint or shade required; the ivory or other dust may be dyed similar to cotton cloth. Gum dammar, copal, mastic, (and if great elasticity is required, bleached india rubber or gutta percha,) answer the purpose very well, either with or without shellac; bees-wax, camphor, and turpentine, are good for some of the purposes, and, according to the ingredients used, it will be perceived that the preparation must undergo various modifications, during the process of manufacture.

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*Experiments to determine the Strength of some Alloys of Nickel and Iron, similar in Composition to Meteoric Iron.** By W. FAIRBAIRN, F. R. S., ETC.

The object of the experiments in this paper was to ascertain whether an infusion of nickel, in a given proportion, would increase the tenacity of cast iron, as originally imagined from the analysis of meteoric iron, found to contain 2½ ℔ cent. of nickel. Contrary to expectation, the cast iron when mixed with the precise quantity of nickel, indicated by the analysis of meteoric iron, lost considerably in point of strength instead of gaining by it. Hopes were entertained that increased toughness and ductility would be the result of the mixture; but the experiments which follow clearly show that there is a diminution in place of an increase of strength.

From the first class of experiments recorded in the paper, it appears that the nickel was prepared from the ore, and melted in the crucible, as follows:—

30 lbs. of roasted ore.
5 lbs. of pure sand.
2 lbs. of charcoal.
2 lbs. of lime.

These were kept six hours in the furnace, and, after being separated from the slag, the metal was cooled and remelted with half a pound of roasted ore and a quarter of a pound of pure bottle glass; about

* From the London Repertory of Patent Inventions, No. 776.

25 ℔ cent. of nickel was obtained. 2½ ℔ cent. of this was fused with Blaenavon No. 3 pig iron, and run into ingots or bars, which were then subjected to experiment as follows:—

Results derived from one inch square bars, subjected to a transverse strain two feet three inches between the supports.

Description of Iron.	Breaking weight in pounds (B.)	Ultimate deflection in inches. (D.)	Power of resisting impact. (B×A.)	Comparative strength, Blaenavon representing 1000.
Exp. I. Bar D. Pure Blaenavon, No. 3	1131	·75	848·2	1000
" II. " C. Blaenavon, No. 3 Nickel	875	·58	507·5	773
"III. " B. Pure Cast Iron, No. 1	861	·47	404·7	761
"IV. " A. Cast Iron, No. 1 Nickel	637	·43	276·4	563
" V. " E. Pontypool, pure No. 1	798	·36	292·1	705
Mean, . . .	860	·52	465·8	760·2

From the above there appears to be a loss of 22 to 26 ℔ cent. as compared with the Blaenavon No. 3 iron; and in the next series of experiments made upon similar mixtures, but with perfectly pure nickel, the same indications of loss are apparent, but not to the same extent as in the preceding, as may be seen from the following results:—

Description of Iron.	Breaking weight in pounds (B.)	Deflection in inches. (D.)	B×A or power to resist impact.	Rates of strength F 2=1000.
Exp. VI. Bar F 1 without Notches,	867	·315	273	1000 : 876
" VII. " F 2 "	989	·380	376	1000 : 1000
" VIII. " G 1 with one Notch,	760	·331	231	1000 : 768
" IX. " G 2 "	899	·410	368	1000 : 908
" X. " H 1 with two Notches,	746	·286	213	1000 : 754
" XI. " H 2 "	703	·290	203	1000 : 810
Mean, . . .	829	·335	280	1000 : 838

Taking the mean of these experiments, it will be observed that the loss of strength is not so great as in the former, it being about 17 ℔ cent., or as 100 : 83. In the deflections and the power to resist impact, they are, however, inferior to those first experimented upon, as may be seen by the numbers, in the ratio of 465 : 280. This in some degree neutralizes the measure of strength, by a proportionate diminution of elasticity of the bars employed in the last experiments.

At the commencement of the paper, the author stated that the experiments were undertaken for the purpose of ascertaining how far, and to what extent, an admixture of nickel would improve cast iron; and that that improvement had reference, independent of other objects, to increased tenacity in the metal employed for the casting of mortars and heavy ordnance.

During the last two years innumerable tests and experiments have been made for that purpose with more or less success; but the ultimate result appeared to be, in the opinion of the author and others, that for the casting, or rather the construction, of heavy artillery, there is no metal so well calculated to resist the action of gunpowder as a perfectly homogeneous mass of *the best and purest cast iron* when freed from sulphur and phosphorus.

In the discussion which followed the reading of the paper, Mr. Calvert said that it was highly probable that nickel caused the increased brittleness of cast iron, just as carbon, phosphorus, and sulphur, but that the result with malleable iron might probably be very different; and, as meteoric iron is malleable, the trial could only be complete when soft iron and nickel were united; nevertheless, these experiments, as far as cast iron is concerned, were decidedly new and of great value.

Proceedings Manchester Society.

Meteors of 10th of August.

Mr. Benj. V. Marsh informs us, that on the evening of the 10th of August, of this year, he saw from 30 to 40 meteors between 9 and 10½ o'clock, although not observing constantly. Fully nine-tenths of them, including all the large ones, were referable to a radiant situated approximately in R. A. 47° 30′, Decl. 58° N.; that is, near the stars B and C of the constellation Camelopard.

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*New Material for Moulds, &c.**

It is proposed to introduce a vast improvement in the casting of metals, by substituting compressed carbon for the sand or clay usually employed. The advantage to be derived is, that the same mould may be used over and over again without injuring the smooth surface of the cast material. The carbon to be employed, which is manufactured under a patent recently granted to Mr. Bühring, is comparatively pure, and can be moulded into any shape and form required. The same material has been successfully applied to the manufacture of crucibles, and these crucibles are by many considered superior to any others. Another purpose to which the compressed carbon is applicable is the manufacture of battery plates; and it is anticipated that electric telegraph companies would effect a vast saving in the cost of their batteries, by employing carbon in connexion with iron, instead of the zinc and copper plates now used. The development of Mr. Bühring's patent is entrusted to a public company, registered under the Limited Liability Act, and called the Moulded Carbon Company. The new material will, no doubt, be used in many cases in which carbon in any other form was valueless, or so difficult to apply that it could not be advantageously employed.

* From the London Mining Journal, No. 1109.

Trial Trip of the Steamer Sestos.

The new iron steamer "*Sestos*," built by Mr. Harrison Loring, at the "City Point Works," South Boston, yesterday made her trial trip down the harbor. About a hundred and fifty gentlemen, including many members of the City Government, composed the excursion party.

The *Sestos* is an iron screw steamer, of about 500 tons burthen, built for the Americans and a native house in Calcutta, for the purpose of carrying passengers and towing large ships up the Hoogly river. She is to be commanded by Capt. F. A. Sampson, who is a part owner, and has supervised her construction throughout. The following is a statement of her dimensions, thickness of iron, &c.:—

Length of keel,	135 feet.
" on deck,	150 "
Breadth of beam,	26 "
Depth of hold,	14 "

Keel of forged iron, 7 feet by 2½ feet.
Frames 3½ by 3⅜ inch; angle iron, spaced 12 inches apart.
Floors of plate iron, 14 inches deep.
Garboard strake, 9-16 inch thick.
Bottom for two strakes, ½-inch.
To above turn of bilge, 7-16 inch.
Remainder to wale strake, ⅜-inch.
Wale strake, 7-16 inch.

The steamer is divided into three water-tight compartments, by bulkheads, one abaft the engines, one forward of the boilers, and one forward of the coal bunkers, all braced with double angle iron. The deck beams are of iron six inches deep. The two engines which operate the steamer are oscillating in their movement; diameter of cylinder 38 ins.; stroke of piston 32 inches. The boilers are "Martin's Patent Vertical Tubular boilers." The ordinary working horse power is 550; but that can be considerably increased. Thirty-three pounds of steam is the amount allowed by the certificate, but several pounds more can be carried with perfect safety. Upon ocean voyages the steamer will go under sail, having three masts, square-rigged at the fore, and schooner-rigged at the main and mizzen masts. All the standing rigging is of coiled wire. In matters of external finish, more regard has been paid to strength and durability than to beauty of appearance, yet the steamer wears a very trim and handsome look. Her cabin is fitted up elegantly. Mr. Loring has forged the iron, framed the wood work, put all the materials together, and completed a whole steamship at his own establishment, a fact which cannot be recorded of many men, however extensive their facilities. And all agree that the work has all been well done.

The trip was in every way satisfactory. The steamer, even in the roughest water, bore herself well, and her machinery performed its work smoothly and thoroughly, scarcely moving the ship at all, it being remarked by all, that there was no perceptible noise or jar—hardly more than would be experienced in a sailing vessel. The arrangements

for the occasion were complete, and the party were much pleased, the storm and rough weather being rather agreeable than otherwise.

The following is the record of the steamer's performance on the downward trip, under less than 24 pounds of steam, the propeller making an average of 35 revolutions per minute, and against a strong east wind and heavy sea:—

	h.	m.
Passed Grand Junction wharf,	12	59
" Fort George,	1	12
" Long Island Light,	1	32
" Nix's Mate,	1	35
" Fort Warren,	1	44
" Outer Light,	1	58

On the inward trip, the pressure of steam was from 24 to 27 pounds, and the propeller made from 40 to 53 revolutions per minute, but there was a heavy sea and strong ebb tide.

	h.	m.
Passed Outer Light,	4	06
" Fort Warren,	4	15
" Long Island Light,	4	24½
" Fort George,	4	46
" Grand Junction Wharf,	4	59

Thus nine miles were made against a 2½ knot tide in 53 minutes.

The "*Sestos*" will make a two days' trip in the course of the present week, with a four-bladed propeller; the one used yesterday having but three blades. Next week she will leave for Calcutta.

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*Consumption of Smoke.**

A short time since, the owners of steam-tugs plying upon the Tyne, to the number of 150, received notice from the Inspector of Nuisances, of Newcastle-on-Tyne, under pain of being proceeded against for penalties under a local Act, to consume the smoke emitted by their boats, which at all times (but more especially on the occasion of busy seatides, when from 100 to 200 vessels have to be towed out at a tide,) issued from the funnels of the steam-tugs in thick volumes of the blackest density. The tug owners thereupon consulted Mr. Armstrong, engineer, of Elswick, and, by his advice, enlisted the services of Dr. Richardson and Mr. Reed, of Newcastle, under whose superintendence experiments have for some time past been carried on, at Elswick, near Newcastle, to prove the practicability of consuming the smoke produced by the coal raised from the great coal-fields of Northumberland and Durham.

It was arranged that one of the steam tugs should be placed at the disposal of Dr. Richardson and Mr. Reed, for the purpose of making such alterations in the furnaces as they considered would effect the desired object, and in order that, in case of success, the other steam-tugs might be altered in a like manner. The *Expert* steam-tug, belonging

* From the Lond. Civ. Eng. and Arch. Journ., Sept., 1858.

to Mr. Wm. Melbourn, of North Shields, was offered for the purpose, and a series of experiments were made upon the furnaces, the plan adopted being very simple, consisting of a proper admission of air into the furnace, which, combined with careful stoking, was expected to consume the smoke. After certain alterations were effected, the tug was taken to sea, with a party of steam-tug owners, and their solicitor, Mr. Kewney, and the inspector of nuisances, on board. It was found that the improvement effected was very great, upwards of 75 per cent. of the smoke being consumed, and the remainder being of a character far less offensive, being thin and light colored. The inspector considered that the result was very satisfactory.

Dr. Richardson and Mr. Reed were determined, however, to effect a perfect consumption of smoke, if possible; and made further alterations. On the 5th ult. the *Expert* proceeded to sea, on a voyage from Newcastle to Warkworth, a distance of 30 miles, having on board Mr. Miller and Mr. Taplin, government engineers (sent from Woolwich and Portsmouth to test the experiments going on at Elswick to consume the smoke, with a view to re-introduce the Northern coal into the naval yards); and also Dr. Richardson and Mr. Reed, and a party of steamboat owners and their solicitor. It was found that the alterations, which were of a simple character and comparatively inexpensive, entirely effected the consumption of the smoke, there being none whatever visible throughout the voyage out or home, except when Mr. Reed, in order to exemplify the efficiency of the system, stopped the admission of the air, and allowed the production of the smoke at pleasure, or the entire consumption, as he thought fit.

The other steam-tugs in the association, and the steam-ferries on the Tyne, will be fitted up with the apparatus forthwith, and it is anticipated that a great nuisance to the river and harbor towns of the Tyne, occasioned every sea-tide by a black fall of smoke hanging over them, and sometimes entirely obscuring the view of the sea, will be entirely removed.

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*On the Influence of Pressure on Chemical Affinity.** By Dr. Lothar Meyer.

In the twelfth volume of Poggendorff's *Annalen*, there is a note by Babinet which contains the proposal to use, as a measure of chemical affinity, the pressure which a gas generated by chemical decomposition must attain in order that the decomposition may cease. The author states that for zinc and sulphuric acid the limit is reached when for 0° C. the pressure of the liberated hydrogen amounts to thirteen atmospheres; at 25° C., on the contrary, this pressure exceeds the height of thirty-three atmospheres.

Experiments which I have made in Prof. Werther's laboratory do not agree with these statements. With the most varied strengths of sulphuric acid, even in the presence of large quantities of different

*From the Lond. Edin. and Dub. Phil. Mag., Aug., 1858.

sulphates, and by the use of citric and acetic acids, the pressure of the hydrogen liberated by zinc far exceeds the limits given by Babinet. The reason of this appears to lie in the fact that Babinet used copper vessels closed by a cock, while I used sealed glass tubes.

The decomposition appears, however, to attain a limit; at any rate the liquid, even with excess of zinc, has still a strong acid re-action after standing for months. But what the maximum of this pressure may be I have not been able to determine, inasmuch as the only tubes I could obtain which would stand the pressure were too narrow to allow a manometer to be introduced. The greatest pressure which I observed directly at the manometer was 66 atmospheres. The acid consisted of one volume SH^2O^4, and three volumes of H^2O; the temperature was 0° C. The tube exploded shortly after observing this pressure.—Poggendorff's *Annalen*, vol. civ., p. 189.

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*On an Experiment in Melting and Cooling some of the Rowley Rag.**

By W. Hawkes, Esq.

About 31 cwt. of basalt was melted in a large double reverberatory furnace, and after a slow cooling during thirteen days, it presented an upper stratum of stony vesicular matter, about 1 inch thick, next a layer of black glass, from 2 to 8 inches deep on that side of the mass which was exposed to the air from the door of the furnace (elsewhere, immediately under the vesicular layer was solid stone, interspersed here and there with air-bubbles). Mr. Hawkes added some observations relating to the results of experiments which he had made to ascertain the temperature of melted cast iron, and of melted basalt.

Aluminium.†

We glean a few interesting particulars respecting this curious metal, from a work entitled *L'Aluminium et les Métaux Alcalins*, just published by MM. Tissier, gentlemen whom we have several times had occasion to notice in our accounts of the labors of the Acadamy of Sciences, and who, in the work alluded to, have enriched the history of that metal with many important observations of their own. It had generally been stated that aluminium could resist the highest temperature without absorbing oxygen, but we now learn that if the temperature be raised from a white to a welding heat, aluminium will burn with great intensity until a stratum of alumina be formed on its surface sufficiently thick to exclude the atmosphere. As regards alloys, that made with iron is not malleable, but will crystallize. An alloy of 100 parts of aluminium and three of nickel is more fusible and harder than the pure metal. Bismuth forms with aluminium, in the proportion of one to three, an alloy which is very fusible, but also very subject to oxidation when in a state of fusion. If two equivalents of aluminium and

* From the Lond. Edin. and Dub. Phil. Mag., Sept., 1858.
† From the London Mining Journal, No. 1201.

one of oxide of lead be exposed to a white heat, a violent detonation ensues, the crucible breaks into pieces, and even the doors of the furnace are driven to a distance. Similar effects occur with oxide of copper, or the sulphates of potash or soda. Aluminium is now much used for jewelry, especially bracelets, pins, and combs; in cabinet making, it is excellent for inlaid work; its lightness renders it extremely convenient for pencil-holders, thimbles, seals, small statues, medallions, vases, and the like; for spectacles, as it does not blacken the skin like silver. But one of its most useful applications consists in using it for reflectors of gas lamps, since it resists the effects of sulphurous emanations, which silver and brass do not.—*Galignani's Messenger.*

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, September 16, 1858.

John C. Cresson, President, in the chair.

John F. Frazer, Treasurer. } Present.
I. B. Garrigues, Rec. Sec. }

The minutes of the last meeting were read and approved.

Donations to the Library were received from the Geographical Society, Vienna, Austria; La Société Industrielle de Mulhouse, France; P. H. Thomson, Esq., Columbus, Tennessee; the City Council, Boston, Mass.; the Evansville Board of Trade, Indiana; and from Charles E. Smith, Esq., Philadelphia.

Donations to the Cabinets were received from Prof. John C. Cresson, Philadelphia, and Barnard Shipp, Esq., Natchez, Mississippi.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of August.

The Board of Managers and Standing Committees reported their minutes.

Candidates for membership in the Institute (6) were proposed, and the candidates (5) proposed at the last meeting were duly elected.

Mr. McWilliams exhibited his new design of an axle-box for railroad cars. The improvement consists in the facility with which it can be taken apart to renew the packing, which frequently forms into a mass so solid as to require hours for its removal from the boxes. Mr. McWilliams' is so arranged that by taking out a bolt the lower part, which forms the packing and oil reservoir, can be drawn outward, entirely clear, so that the packing is removed without difficulty in one mass. By elevating the car body, an opportunity is given for the removal of the brass box upon which the axle runs, while the upper part of the axle-box remains in its position. The inner end of the lower piece fits into a rebate cast in the upper piece, so that it remains in place at the inner end, while the outer end is secured by the bolt named.